SANBORN HEAD

Mr. Kevin Bilash
USEPA Region III
Land, Chemicals & Redevelopment Division 3LD20
1650 Arch Street
Philadelphia, PA 19103

September 30, 2022
File No. 4862.07

Re: Marcus Hook Terminal
Monthly Progress Report – September 2022
Area of Interest 7
Marcus Hook, PA

Dear Mr. Bilash:

This monthly progress report is being submitted on behalf of the Evergreen Resource Management Operations (Evergreen) for Area of Interest (AOI) 7 at the Marcus Hook facility. Note that on March 1, 2022, Sunoco Partners Marketing & Terminals L.P. changed its name to Energy Transfer Marketing & Terminals L.P. (Energy Transfer) and the facility changed its name from Marcus Hook Industrial Complex (MHIC) to Marcus Hook Terminal (MHT). On December 9, 2021, a Revised Interim Measures (IM) Workplan was submitted to the United States Environmental Protection Agency (USEPA) to address arsenic in the subsurface at AOI 7. The IM Workplan was approved by the USEPA on February 15, 2022. The discussion below provides an update on IM pre-design investigation (PDI) activities and Bench Scale Treatability Study activities.

Activities completed this reporting period

Bench Scale Treatability Study activities occurred in the treatability lab at Terra Systems, Inc. (Terra Systems) in Claymont, Delaware. Specifically, rebound test activities were completed in accordance with the Revised IM Workplan. Note that the results of the treatability testing will be submitted in a future progress report once the Bench Scale Treatability Study is completed.

Field activities that were completed during this reporting period (September 2022) include pressure transducer deployment and groundwater gauging activities. These activities are not included in the Revised IM Workplan but were completed to support the selection of the confirmatory porewater sampling locations requested by the USEPA during an August 15, 2022 conference call. Evergreen installed pressure transducers within AOI 7 on September 19, 2022 as described below:

- Pressure transducer deployment was completed at:
  - 11 shallow monitoring well locations (MW-56, MW-558, MW-559, MW-560, MW-509, MW-606S, MW-607S, MW-530U, MW-531U, MW-532U, MW-534U),

- 13 deep monitoring well locations (MW-56D, MW-558D, MW-559D, MW-560D, MW-509D, MW-606D, MW-607D, MW-608D, MW-609D, MW-530L, MW-531L, MW-532L, MW-534L), and
- The stilling well.

The pressure transducers were calibrated and programmed prior to deployment in the field and recorded measurements throughout one low and one high tide cycle, for a total deployment of approximately 6 hours. The intent of the pressure transducer deployment was to have simultaneous groundwater elevation measurements to negate any variations in groundwater elevations due to manual measurements in a tidal environment. Groundwater gauging was completed at the monitoring wells noted above where transducers were deployed (24 wells), two staff gauges, and the stilling well to have manual measurements to correlate with the data from the transducers.

Activities planned for the next reporting period

The activities planned for the next reporting period (October 2022) include the following Treatability Study activities, as described in the Revised IM Workplan, and field activities:

- Continuing rebound test activities in accordance with the Revised IM Workplan.
- Additional porewater sampling in accordance with the Porewater Sampling Plan technical memorandum provided in Attachment A.

Deviation from approved activities this reporting period

There were no deviations from the approved activities for this reporting period.

Deviation from approved schedule

There were no schedule deviations during this period.

The schedule for the major milestones is provided below and the detailed schedule is included in Attachment B.

Task	Schedule
PDI Activities	3/2022 – 5/2022
Bench Scale Treatability Testing	5/2022 – 10/2022
Additional Porewater Sampling	10/2022
Pilot Testing	On pause
IM Performance Monitoring	On pause

The August 2022 progress report noted that a Porewater Sampling Plan would be provided as an attachment to this next monthly report to discuss the plan for confirmatory porewater sampling at specific locations. The additional porewater sampling is planned for October 24, 2022 through October 28, 2022 by Sanborn, Head & Associates with their subcontractor Normandeau Associates (Normandeau). As requested by the USEPA during the August 15, 2022 meeting, Sanborn Head has prepared a technical memorandum summarizing the Porewater

Sampling Plan for additional porewater sampling at select locations, which is provided as Attachment A to this monthly progress report.

Very truly yours,
SANBORN, HEAD & ASSOCIATES, INC.

Colleen Costello, PG
Senior Vice President

CSS/CC: css

Attachments
Attachment A – Porewater Sampling Plan Technical Memorandum
Attachment B – Interim Measures Implementation Schedule

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ATTACHMENT A to the September 2022 Monthly Progress Report

CONFIRMATORY POREWATER SAMPLING PLAN

SANBORN HEAD

SANBORN HEAD

1155 Business Center Drive, Suite 210
Horsham, PA 19044

TECHNICAL MEMORANDUM

To: Kevin Bilash
From: Colleen Costello
File: 4862.07
Date: September 30, 2022
Re: 2022 Confirmatory Porewater Sampling Plan
cc: Tiffani Doerr, Chelsey Shepsko

1.0 INTRODUCTION

The Revised Interim Measures Workplan (IM Workplan) was prepared on behalf of Evergreen Resource Management Operations (Evergreen) for Area of Interest (AOI) 7 located within the Marcus Hook Terminal (MHT or Site). The MHT is located in southeastern Pennsylvania and northern Delaware on the Delaware River. AOI 7, which is located within MHT, is located in Delaware and consists of approximately 50 acres of land bounded on the southeast by the Delaware River, the southwest by a property boundary with Honeywell's Delaware Valley Works (DVW) and by the Pennsylvania-Delaware state line on the northeast. Middle Creek runs east-west then turns and runs north-south through AOI 7, as shown in Figure 1. Honeywell's DVW property, is a former chemical manufacturing plant located in Claymont, Delaware and Marcus Hook, PA. The DVW consists of approximately 100 acres, which is divided by Route 13 into two separate plants, referred to as the "North Plant" and "South Plant". The South Plant includes Solid Waste Management Unit 9 (SWMU 9) which was used for disposal of pesticides and related wastes, including arsenic. SWMU 9 is located adjacent to the MHT AOI 7 site. A drainage channel referred to as "the sluiceway" traverses the southern portion of the South Plant and discharges to the Delaware River approximately 900 feet downstream of Middle Creek. The location of the South Plant and SWMU 9 is shown on Figure 1.

The IM Workplan (approved by the United States Environmental Protection Agency (USEPA) on February 15, 2022) included proposed sediment and porewater sampling activities. The sediment and porewater sampling were completed between March 22, 2022 and March 25, 2022 by Sanborn, Head & Associates (Sanborn Head) with their subcontractor Normandeau Associates (Normandeau) in accordance with the approved IM Workplan. A technical memorandum (Sediment and Porewater Sampling technical memorandum) was submitted to the USEPA on May 27, 2022 to document the sample collection methodology and results of the sediment and porewater sampling activities. Following submission of this technical memorandum, the United States Army Corps of Engineers (USACE) conducted a review of the methodology and results of the sediment and porewater collection.

A conference call with the USEPA and Evergreen was held on August 5, 2022, during which the USEPA shared the results of the USACE review of Evergreen's 2022 Sediment and Porewater Sampling technical memorandum. The USACE review determined that Evergreen's sediment

and porewater sampling methodology results were valid. The USEPA also reported that the USACE determined that the results from the USACE 2018 porewater sampling event were valid. A follow up conference call with the USEPA and Evergreen on August 15, 2022 discussed next steps for the IM. During this call, the USEPA requested that Evergreen complete confirmatory porewater sampling at some of the previously sampled porewater locations. The USEPA also requested that Evergreen consider the potential influence of preferential pathways in groundwater in relation to the locations for the confirmatory porewater sampling.

Evergreen is providing this Confirmatory Porewater Sampling Plan as an attachment to the September 2022 IM Monthly Progress Report to conduct confirmatory porewater sampling to demonstrate that, consistent with the March 2022 porewater sampling event, porewater is not present at concentrations above the arsenic porewater preliminary remediation goal (PRG) of 1,253 micrograms per liter (ug/l) established by the USEPA for the Site. This plan also includes a discussion of the data collection and evaluation completed by Evergreen to address the USEPA's request to evaluate the potential influence of preferential pathways in groundwater while selecting the confirmatory porewater sampling locations. The Corrective Measure Study (CMS) will include the full documentation of the completed IM Workplan activities, including data validation. This Confirmatory Porewater Sampling Plan only includes the information reviewed to support Evergreen's rationale for the selection of the confirmatory porewater sampling locations.

2.0 REVISED IM WORKPLAN ACTIVITIES

Evergreen has completed soil, groundwater, sediment and porewater investigation activities in accordance with the IM Workplan. These activities included:

- The installation of four monitoring wells (MW-559D, MW-560D, MW-608D and MW-609D) and one boring AOI7-BH-22-001.
- Collection of 60 soil samples for analysis including arsenic, iron, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total organic content (TOC) analysis, Atterberg limits, and grain size analysis (not all soil samples have had each of these analyses).
- Installation of the stilling well in the Delaware River.
- Completion of water level gauging at 55 AOI 7 monitoring wells, two staff gauges, and the stilling well.
- Deployment of a colloidal borescope in 9 monitoring wells (MW-531U, MW-559, MW-559D, MW-560, MW-560D, MW-606S, MW-606D, MW-608D, MW-609D) to determine spot groundwater flow direction based on true North direction as well as the groundwater flow velocity.
- Groundwater sampling and analysis for dissolved arsenic, dissolved iron, sulfate and sulfide from MW-509, MW-509D, MW-531L, MW-532L, MW-533L, MW-56D, MW-559D, MW-560, MW-560D, MW-606S, MW-606D, MW-607D, MW-608D, MW-609D.
- Pressure transducer deployment at four shallow monitoring well locations (MW-559, MW-560, MW-531U, MW-606S), six deep monitoring well locations (MW-608D, MW-606D, MW-532L, MW-609D, MW-559D, MW-560D), and the stilling well in May 2022. Additional transducer data was collected from 11 shallow monitoring well locations (MW-56, MW-558,

MW-559, MW-560, MW-509, MW-606S, MW-607S, MW-530U, MW-531U, MW-532U, MW-534U), 13 deep monitoring well locations (MW-56D, MW-558D, MW-559D, MW-560D, MW-509D, MW-606D, MW-607D, MW-608D, MW-609D, MW-530L, MW-531L, MW-532L, MW-534L), and the stilling well on September 19, 2022 in support of the development of this Confirmatory Porewater Sampling Plan.

- Soil and groundwater samples were collected for the treatability study in accordance with the IM Workplan.
- Collection of 30 sediment samples for arsenic.
- Collection of 11 porewater samples for dissolved arsenic using the peristaltic pump. Additional porewater samples were also collected using alternative collection methods.

The soil, groundwater, sediment, and porewater analytical data from these activities have been submitted to the USEPA with the monthly progress reports and are summarized on Tables 1 - 4. Section 3 provides additional information concerning both the historic and IM Workplan porewater sampling activities to provide additional context for the confirmatory porewater sampling to be completed by Evergreen in October 2022. The data collected as part of the IM Workplan activities have also been incorporated into the Conceptual Site Model's (Section 4) tables and figures, as appropriate, to support selection of the supplemental porewater sampling locations.

3.0 PREVIOUS POREWATER SAMPLING ACTIVITIES

Previous porewater sampling activities had been conducted in the Delaware River as part of 2016 investigations along the shoreline of the adjacent DVW property, as part of 2018 investigations completed by the USACE along the shoreline of AOI 7, and in March 2022 by Evergreen along the shoreline of AOI 7. The results from these events were summarized in the May 2022 Sediment and Porewater Sampling technical memorandum. The porewater sampling from these events are briefly summarized in this section to provide additional context for confirmatory porewater sampling to be completed by Evergreen in October 2022.

3.1 2016 DVW Sediment and Porewater Sampling

As documented in the March 201*7, Supplemental Pathway Investigation Results Report* prepared by Anchor QEA, LLC and summarized in Evergreen's IM Workplan, porewater sampling was completed at the DVW site to collect data to further assess the fate of arsenic (and other compounds of concern (COCs) not related to the scope of the IM Workplan) in groundwater potentially discharging from the DVW Site to the nearshore sediments of the Delaware River.

During this sampling event, porewater samples were collected at ten sample locations from two sample depths (0 – 10 cm and 11 – 120 cm). Porewater recovery was attempted at multiple locations via micro push point sampler with very limited recovery (less than 50 milliliters [mL]) throughout multiple hours of collection. Various field adjustments were attempted to increase porewater recovery including relocation of the porewater sampler within a one-foot radius and allowing multiple hours for the sampler to remain in place with the tubing system sealed to prevent surface water and atmospheric influence. During attempts to draw from the push

points, filter socks became caked with fine-grained sediment and a silty slurry was pulled from various locations with very little water. Anchor QEA submitted a field memorandum to the USEPA on November 8, 2016, that identified modifications to the Work Plan requirements for porewater collection, which was approved on November 8, 2016. These modifications included collection of additional sediment cores (one per each of the ten locations) to send to the laboratory for centrifuge analysis to extract and sample porewater. A total of ten porewater samples were extracted for analysis using the centrifuge. The locations and results of the porewater sampling from this event are summarized on Figure 2**.**

3.2 2018 USACE Porewater Sampling

As documented in the *January 2019 Delaware Valley Works Pore Water Sampling Event Report* prepared by the USACE and summarized in Evergreen's IM Workplan, porewater sampling was completed off the AOI 7 shoreline in 2018 by the USACE for the collection of porewater samples (Figure 2) to be analyzed for total and dissolved arsenic. During this sampling event, porewater samples were first attempted to be collected using a disposable, 60 mL plastic syringe attached to Teflon® tubing and a vacuum was placed on the system by pulling the plunger up on the syringe. Filtration of the dissolved arsenic samples was attempted with small cartridge filters affixed to the end of the syringe, but these filters clogged with solids almost immediately, resulting in the submission of unpreserved water samples for laboratory filtration followed by analysis for dissolved arsenic. A total of five samples were collected during the USACE first porewater sampling attempts and only two of these samples were analyzed by the laboratory for total and dissolved arsenic. Three locations (locations 5, 6, and 7 as shown in Figure 2 as USACE-5, USACE-6 and USACE-7) could not be laboratory filtered due to high levels of organic material resulting in no dissolved arsenic samples for these locations.

The USACE then modified their sampling methodology during the second attempt at porewater sampling to use a peristaltic pump instead of the syringe, which allowed for the withdrawal of more porewater and the ability to field filter the dissolved arsenic samples using an in-line filter. The USACE collected three porewater samples (locations 2, 3 and 4) using this method and analyzed samples for total and dissolved arsenic. Even using the peristaltic pump, a sample could not be collected at sample location 1 (see Figure 2) due to the high silt content in the sediment matrix at this location. Four sampling attempts were completed for this location by the USACE and no sample was able to be collected. Due to the sampling difficulty the porewater samples were collected during low to high tide conditions.

Based on the laboratory's inability to filter the samples from locations 5, 6 and 7 and the inability for the field collection at location 1, no dissolved arsenic porewater concentrations were reported for four out of the nine locations during the two porewater sampling attempts during the 2018 USACE sampling event.

3.3 Evergreen March 2022 AOI 7 Porewater Sampling

Porewater samples were collected in the Delaware River, adjacent to the AOI 7 shoreline, to delineate arsenic in porewater to the arsenic groundwater PRG of 1,253 ug/L in accordance with the approved IM Workplan. The porewater sampling was completed between March 22,

2022 and March 25, 2022. Figure 2 shows the porewater sampling locations from this sampling event. The locations of Evergreen's March 2022 porewater samples were selected based on the locations of the porewater samples collected by the USACE in 2018.

3.3.1 Evergreen March 2022 Porewater Sampling Methodology

The first step of the porewater sampling process during the Evergreen March 2022 sampling was to measure water quality parameters using a Myron Ultrameter Model 6P meter (Myron) to obtain field readings for conductivity, oxidation-reduction potential (ORP), pH and temperature to verify that the sample represented porewater, not surface water. Once samples were confirmed to be consistent of porewater, six-foot long push point samplers (used during the USACE and DVW sampling events) and a peristaltic pump with an in-line 0.45 micron filter were used for porewater sample collection.

As discussed in the May 27, 2022 Sediment and Porewater Sampling technical memorandum, the IM Workplan allowed for two attempts at each location to collect a porewater sample via push point sampler and peristaltic pump. If the peristaltic pump failed to yield results after two attempts, then a sediment sample was to be collected and sent to the laboratory for centrifugation to extract porewater from sediment. Additionally, diffusive gradient in thin film (DGT) samplers were deployed at certain locations as a passive sampling collection method for dissolved arsenic in porewater. Since centrifuge and DGT sample collection methodology are not proposed to be used for the Confirmatory Porewater Sampling Plan, only the sample results from the peristaltic pump collection method will be discussed further in this section.

Porewater samples were able to be collected from four out of 30 locations within the two allotted attempts via peristaltic pump. Difficulty in collection was due to clay caked on the push point sample port, silt-laden water that would clog the push point sampler and/or 0.45 micron filters, and low volume recovery (approximately 5 to 10 mL of surface water followed by no porewater recovery at all). These observations were similar to the observations described during the DVW and USACE porewater collection activities.

After the two porewater collection attempts were made at each location, Evergreen (in agreement with the USEPA on March 23, 2022) increased the attempts made using the peristaltic pump to collect porewater samples, increased the sampling time, decreased the sample volume, and varied the sampling location or depth to facilitate sample collection.

Following the revised protocol, additional porewater samples were attempted at 15 locations. During this additional sampling, the following items were varied to attempt to retrieve a porewater sample:

- Sampling at varying depths within a 0.2 to 0.8 feet (ft) interval,
- Sampling within a 20-ft radius of the original proposed location,
- Using up to five 0.45 micron filters per sample, since these locations had silt-laden porewater recovery that clogged the filters,

- Collection of samples that were less than the 150 mL originally requested for laboratory analysis of dissolved arsenic were collected,
- Taking out the screen in the push point sampling port, and
- Allowing for very slow porewater recovery (up to 20 minutes).

Using these modifications, porewater samples were able to be collected at seven of the 15 locations, which took an additional two days of field effort to achieve. Due to the sampling difficulty, the porewater samples were collected during low to high tide conditions.

3.3.2 Porewater Sampling Results

Dissolved arsenic concentrations in porewater collected via the peristaltic pump method are provided in Figure 2**.** The dissolved arsenic concentrations in porewater from the 11 locations that were able to be collected via peristaltic pump ranged from non-detect to 442 ug/L. These concentrations were well below the arsenic in groundwater PRG of 1,253 ug/L. As shown in Figure 2, the higher concentrations of dissolved arsenic in porewater from the March 2022 Evergreen sampling event generally correlate with the locations where higher arsenic in sediment (Figure 3) was observed in the March 2022 sampling event.

3.4 Discussion of Evergreen 2022 Porewater Results and USACE 2018 Porewater Results

Results for dissolved arsenic in porewater (Figure 2) from the 2016 DVW event ranged from 40 ug/L to 417,000 ug/L. The highest dissolved arsenic concentrations were found along the western SWMU 9 shoreline. DVW sample locations toward the AOI 7 shoreline are consistent with results from the 2022 Evergreen sampling event. Results for the five dissolved arsenic in porewater samples from the 2018 USACE event (Figure 2) ranged from 382 ug/L to 9,410 ug/L. These results were higher than the 2022 Evergreen results at three locations, USACE-2, -3, and -4. Water quality parameters were collected for river and porewater during both the 2022 Evergreen event and the 2018 USACE event which were determined to be consistent between the two events and the surface water quality parameters were noticeably different compared to its porewater pair from both the 2018 USACE and 2022 Evergreen sampling, supporting that both sampling events collected porewater samples.

As shown on Figure 2, the 2018 USACE sample locations that had results above the 1,253 ug/L PRG (USACE-2, -3 and -4) were delineated via peristaltic pump collected porewater as follows:

- USACE-2 (9,410 ug/L)
  - To the west by USACE-8 (115 ug/L)
  - To the south by PW-09 (10.7 ug/L)
  - To the east by PW-04 (442 ug/L)
- USACE-3 (6,650 ug/L)
  - To the west by PW-04 (442 ug/L)
  - To the south by PW-09 (10.7 ug/L)
  - To the east by PW-16 (7.7 ug/L)
- USACE-4 (3,850 ug/L)
  - To the west by PW-04 (442 ug/L)

- To the south by PW-14 (47.6 ug/L)
- To the east by PW-16 (7.7 ug/L)

4.0 CONCEPTUAL SITE MODEL

Section 7.0 of the IM Workplan presented a conceptual site model which was updated based on the data collected during the implementation of the IM Workplan in support of the selection of the supplemental porewater sampling locations. Figure 4 includes the updated Site plan showing the completed sampling locations from the IM Workplan.

4.1 Site Description and Historical Site Use

AOI 7 is part of the MHT facility that has a long history of petroleum transportation, storage, and refining of fuels and petrochemicals. Operations began in 1902, and the facility was owned and operated by Sunoco since its inception as Sun Oil in 1901. AOI 7 was generally undeveloped until the late 1950s. Prior to development, AOI 7 generally consisted of a low-lying floodplain and marsh area, as shown by the 1898 historical topographical map included in Revised IM Workplan, and included in Attachment A. The 1938 historical aerial shows the depositional areas from the neighboring Honeywell's DVW property into the southwestern portion of AOI 7. The surface of AOI 7 was significantly modified by filling and Middle Creek was relocated several times during development between 1930s to late 1950s as shown in the historical aerials presented in Attachment A. The 1953 aerial depicts the former orientation of Middle Creek, before its final re-routing to its present-day orientation. The 1958 aerial shows the construction of land within the southwestern portion of AOI 7.These site features were considered for the conceptual site model discussion since it is helpful to understand depositional patterns related to potential source areas and former surface water features that may influence current day groundwater flow.

4.2 Geology

The geology in AOI 7 consists of fill underlain by a silts/silty sand underlain by silty clay, underlain by sands and gravels (Trenton Gravel) underlain by bedrock. A cross section location map is included as Figure 5 and the AOI 7 geology is shown on Figure 6 (East – West, cross section A-A' and C-C' along the Delaware River) and Figure 7 (North – South, cross section B-B' along Middle Creek). These cross sections have been updated with the geologic information collected during the Revised IM Workplan activities. These additional data did not change the geologic interpretation presented in the Revised IM Workplan, as summarized below:

- The fill is thicker towards the Delaware River due to the filling completed to make land.
- The silts and silty clay shown in Figure 6 and Figure 7 represent the top of the Delaware River sediments before AOI 7 was filled, which is underlain by sand and gravel.
- The surficial geology in SWMU 9 is dominated by the alum waste that represents a significant portion of the made land in SWMU 9. This alum waste extends to MW-124S and MW-560 based on the white material noted in the boring logs. The deep wells in SWMU 9 (MW-123D and MW-124D) shown on Figure 4 are screened in the sand and gravel unit below the silty clay, which is a different geologic unit and lower in elevation than the deep wells in AOI 7.

4.3 Hydrogeology

Two groundwater units, shallow and deep, have been characterized within AOI 7. Both the shallow and deep groundwater units are unconfined and are interconnected. Generally, the shallow monitoring wells are screened in the fill unit and the deep monitoring wells are screened in the deeper fill, silty clay in AOI 7, as shown in Figures 6 and 7. Within SWMU 9, the shallow wells are screened in the fill or waste and the deep wells are screened in the sand and gravel unit.

Both the Delaware River and Middle Creek are tidally influenced surface water bodies. Groundwater elevations along the tidal Delaware River are influenced by semidiurnal tides. A tidal study completed as part of the 2016 RFI showed the effects of tidal stage in the Delaware River on groundwater elevations were significant along the Delaware River but were diminished at a distance of 250 feet from the river (e.g., as seen in MW-533U). Another important observation from the 2016 tidal study is that for a portion of the tidal stage, groundwater is at a lower elevation than the adjacent surface water in the Delaware River, indicating that the groundwater flow into the river is reduced.

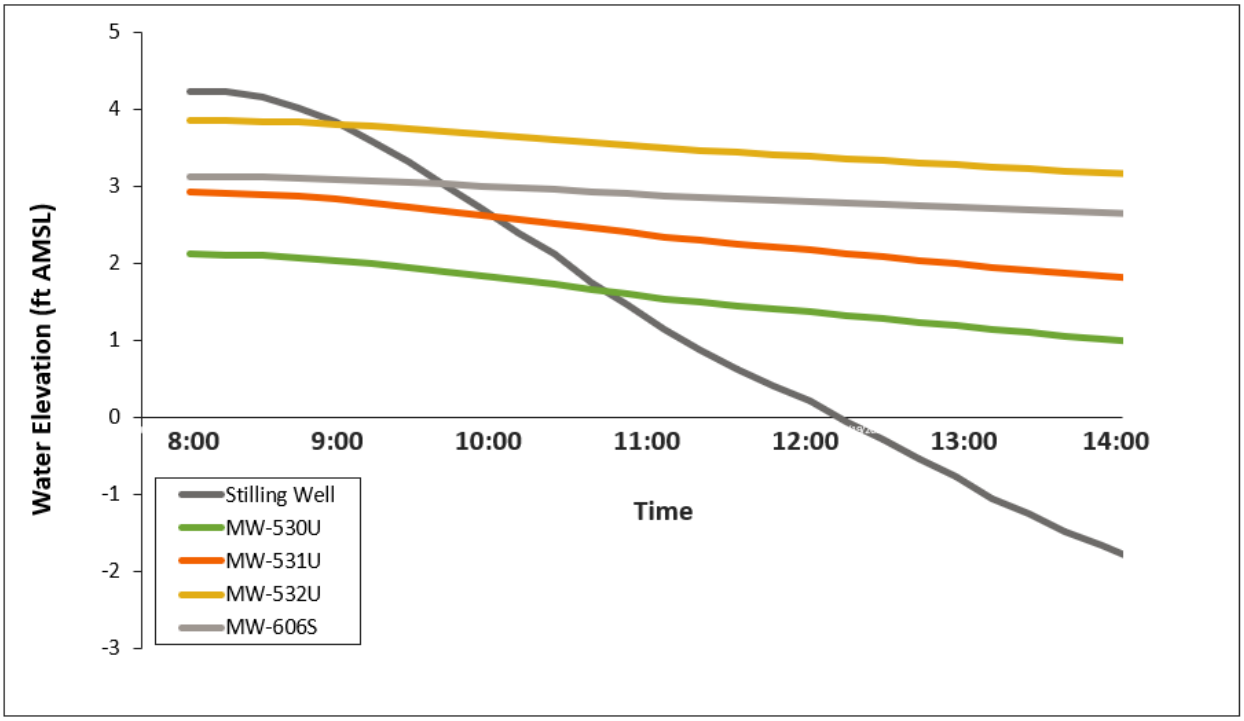
Fieldwork was completed in September 2022 to collect additional information concerning groundwater elevations and tidal influences along the Delaware River frontage with AOI 7, especially in the southwest corner of AOI 7, to support development of this Confirmatory Porewater Sampling Plan. Pressure transducers were installed in 11 shallow wells (MW-56, MW-558, MW-559, MW-560, MW-509, MW-606S, MW-607S, MW-530U, MW-531U, MW-532U, MW-534U), 13 deep monitoring wells (MW-56D, MW-558D, MW-559D, MW-560D, MW-509D, MW-606D, MW-607D, MW-608D, MW-609D, MW-530L, MW-531L, MW-532L, MW-534L), and one within the stilling well in the Delaware River. The pressure transducers used for this evaluation were Solinst Levelogger 5 (with a barologger) that are capable of withstanding saltwater conditions. The pressure transducers were installed on September 19, 2022 by Sanborn Head staff at the start of high tide (approximately 08:00) through the low tide period (at approximately 14:00). Measurements were collected every 15 minutes and were correlated with multiple manual water level measurements that were taken during that period at each well using a Solinst oil-water interface probe. Because the transducer measurements were recorded at the same time, groundwater contours generated from the transducer data more accurately reflect groundwater flow at that time, without any potential distortion due to tidal effects based on differences in data collection timing. Therefore, the groundwater contours generated from the September 19, 2022 transducer event were used for this conceptual site model discussion rather than the site-wide groundwater elevations collected in May 2022.

Shallow Groundwater

Figures 8 and 9 show the groundwater contours at high and low tide, respectively, in the shallow groundwater based on the September 19, 2022 pressure transducer deployment. As shown in Figures 8 and 9, representing the shallow groundwater during low and high tide, respectively, groundwater flow is toward the south/southwest, but with a discharge area near MW-531U, with a steeper gradient observed during low tide conditions.

Figure 4.3A below shows the shallow groundwater elevation data from the September 19, 2022 transducer data collected from the AOI 7 shoreline shallow wells and the Delaware River elevations on September 19, 2022. As shown in Figure 4.3A, during higher tide, the Delaware River elevation is above the groundwater elevation and groundwater does not discharge to the Delaware River. Based on the shallow well pressure transducer data and stilling well data, the shallow groundwater is at a higher elevation than the Delaware River approximately 75% of the tidal cycle. During the September 19, 2022 transducer groundwater event, the surface water elevation in Middle Creek was 3.5 to 3.6 ft AMSL. Flow in Middle Creek is very variable, with a tidal range of up to 6 feet. Evergreen surveyed the elevation of Middle Creek bed surface in May 2021 to be -1.7 ft AMSL. The elevation of the Middle Creek bed is generally within the screened interval of the shallow wells and above the screened interval of the deep wells.

Figure 4.3A – Shallow Groundwater Elevation over Time from September 19, 2022 Transducer Data

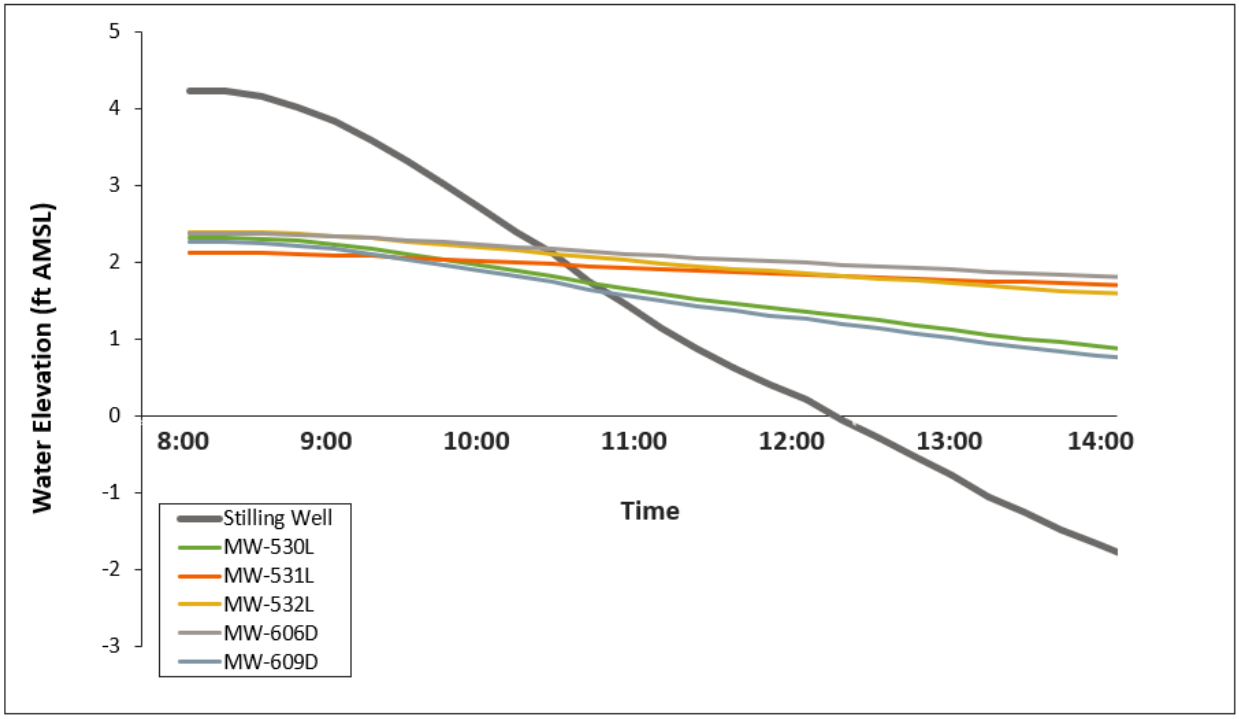


Deep Groundwater

Figures 10 and 11 show the groundwater contours at high and low tide, respectively, in the deep groundwater based on the September 19, 2022 pressure transducer deployment. As shown in Figures 10 and 11, the groundwater flow direction fluctuates in deep groundwater from a southwesterly flow direction (but with a groundwater low in the vicinity of MW-531L during high tide conditions) to an overall more southernly flow direction with a localized groundwater high in the vicinity of MW-531L during low tide conditions, with localized southwestern discharge area in the vicinity of MW-609D.

Figure 4.3B below shows the groundwater elevation of the shoreline deep wells and the Delaware River elevations on September 19, 2022. As shown in Figure 4.3B, at higher tide, the Delaware River elevation is above the deep groundwater elevation. Based on the deep well pressure transducer data and stilling well data, the deep groundwater elevations are above the Delaware River elevations approximately 65% of the time in the tidal cycle. The data in Figure 4.3B also demonstrate the localized reversal of flow direction between MW-531L and MW-530L/MW-609D. During high tide, the groundwater elevation in MW-531L is lower than MW-530L/MW-609D but this reverses as the tidal cycle progresses towards low tide. Also worth noting is the larger groundwater fluctuation observed in MW-530L and MW-609D and the other wells during low tide than what is observed under high tide conditions. These localized variations in flow direction can also be seen in the borescope data in Attachment B.

Figure 4.3B – Deep Groundwater Elevation over Time from September 19, 2022 Transducer Data



Vertical Gradients

The graph in Attachment B, which includes the transducer data for all shallow and deep groundwater wells from the September 19, 2022 event, further demonstrates vertical gradients between the shallow and deep groundwater units. As shown by this graph, there generally is an upward gradient from the deep to shallow groundwater units along the Delaware River. However in some instances the gradient changes to a downward gradient during low tide.

4.4 Distribution of Arsenic in Soil and Groundwater

As previously discussed, the IM Workplan fieldwork was conducted in April through May 2022 and included the installation of four wells and one soil boring: MW-559D, MW-560D, MW-608D, MW-609D, and AOI7-BH-22-001 (Figure 4). Soil samples were collected for arsenic

analysis as well as iron, BOD, COD, TOC, grain size analysis, and Atterberg limits. Groundwater samples were collected and analyzed for dissolved arsenic, dissolved iron, sulfate, and sulfide. The focus of the following discussion will be on arsenic distribution in the subsurface.

The distribution of arsenic in soil (mg/kg) at AOI 7 is depicted in Figure 12, which shows the highest arsenic in soil concentration found in each soil boring. As discussed in the IM Workplan, arsenic mass in soil in AOI 7 is primarily located in the southwestern corner of AOI 7. Figures 13 and 14 show the updated cross sections from the IM Workplan with updated arsenic isopleths based on the results of the IM Workplan activities. The highest level of arsenic in soil in AOI 7 was found at MW-608D in the 30 to 35 ft below ground surface (bgs) interval (-8.7 to – 13.7 ft above mean sea level (AMSL)), which is consistent with the highest level of arsenic found at SWMU-9 (along the shoreline of Middle Creek at MW-124D with arsenic concentration of 14,100 mg/kg at -9.13 to -11.13 ft AMSL). This high level of arsenic in MW-608D (and across the site) is mostly located on the top of the silty clay layer in accordance with the conceptual site model that it was deposited onto of the Delaware River sediment from the Honeywell's DVW properties before this portion of AOI 7 was made land. Figure 12 also shows the arsenic in sediment results during the Evergreen March 2022 sampling event. The highest concentration of arsenic in sediment was at SED-04 at 353 mg/kg and was located immediately downgradient of MW-608D and MW-609D, which is consistent with the distribution of arsenic in soil based on the conceptual site model.

The distribution of arsenic in groundwater (ug/L) at AOI 7 is depicted in Figure 15, which shows the most recent arsenic in groundwater concentration found in each monitoring well (in addition to porewater results). As seen with the distribution of arsenic in soil, the distribution of arsenic in groundwater is located in the southwestern corner of AOI 7. The highest concentration of arsenic from the four new monitoring wells was 633,000 ug/L at MW-609D, however, the highest concentration of arsenic in groundwater at the site is located at MW-532L (just to the east of MW-609D) at 1,430,000 ug/L. The overall distribution of arsenic in groundwater shows higher concentrations in the deeper aquifer, consistent with the distribution of arsenic in soil at deeper elevations, and as shown in the updated cross-sections with arsenic in groundwater isopleths in Figures 13 and 14.

Porewater results from the USACE, DVW, and Evergreen sampling events are also provided in Figure 15**.** The highest arsenic in porewater concentration from the USACE event was at LOC-002 at 9,639 ug/L. The highest arsenic in porewater concentration from the 2022 Evergreen sampling event was at PW-04 which is located east of LOC-002 (i.e., USACE-2) and downgradient of MW-609D. Note that the Evergreen porewater results from March 2022 are below the arsenic in groundwater PRG of 1,253 ug/l.

4.5 Preferential Pathway Evaluation

Figures 16 and 17 combine several elements of the conceptual site model to evaluate if any preferential pathways for groundwater exist which would be targeted during the supplemental porewater sampling. Figure 16 includes the September 19, 2022 deep groundwater contours during high tide, an outline of the wells with groundwater results above the PRG of 1,253 ug/l

based on historical and current groundwater results, the 1953 orientation of Middle Creek and the 1958 made land boundary in the southwestern portion of AOI 7. Figure 17 includes all of these elements but for the September 19, 2022 deep groundwater contours during low tide. The deep groundwater contours were selected for these figures because the majority of the arsenic contamination in groundwater is present in the deep groundwater unit. Preferential pathways were not identified based on observed geologic conditions, but areas with localized increased gradients/discharges were identified in the vicinity of MW-531L and MW-608D/MW-609D as shown on these figures.

4.6 Arsenic Mass Discharge

Mass discharge calculations were performed for arsenic in groundwater across the AOI 7 shoreline based on the dissolved arsenic distribution in groundwater and groundwater flow direction. Details for these calculations are provided in Attachment C. The mass discharge across the AOI 7 shoreline is approximately 0.039 g/d of arsenic. Assuming a dilution factor of 10,000 for groundwater to surface water discharge in the Delaware River (based on the March 28, 2018 CorMix Modelling Memo provided in Appendix M of the April 8, 2019 Revised RCRA Facility Investigation Report), the anticipated concentration in the Delaware River immediately off the AOI 7 shoreline is 0.052 ug/L. This concentration is below the arsenic in groundwater PRG of 1,253 ug/L and is consistent with the arsenic in porewater concentrations across the AOI 7 shoreline that were collected in March 2022 by Evergreen that were also below the PRG.

5.0 SUPPLEMENTAL POREWATER SAMPLING PLAN

Seven supplemental porewater sampling locations are proposed based on the results of the previously porewater sampling results and the conceptual site model discussion in Section 4.0. The proposed locations are shown in Figure 18 and are:

- PW-01B – a confirmatory location of USACE 2 (LOC-002),
- PW-02B – a step out location from PW-01B (and confirmatory location for USACE 7),
- PW-04B – a confirmatory location for PW-04,
- PW-07B – a confirmatory location for USACE 3 (LOC-003),
- PW-10B – a confirmatory location for PW-10,
- PW-13B – a confirmatory location for USACE 4 (LOC-004), and
- PW-16B - a confirmatory location for PW-16.

Locations PW-01B, PW-04B, PW-07B, PW-10B, PW-13B, and PW-16B are located immediately downgradient of the area of arsenic mass discharge across the AOI 7 shoreline. Additionally, locations PW-01B and PW-07B are co-located with USACE porewater sampling locations that could not be collected during the Evergreen porewater sampling event in March 2022. PW-02B is a step-out location for PW-01B that also could not be collected in March 2022 by Evergreen and is located downgradient of the highest arsenic in porewater concentration from the USACE porewater sampling event. Evergreen will attempt to collect the porewater samples during low to mid-tide cycles when the surface water elevation in the Delaware River is lower than groundwater elevations along AOI 7 shoreline.

5.1 October 2022 Porewater Sampling Methodology

The following porewater sampling methodology is consistent with the Evergreen March 2022 porewater sampling event methodology that was provided in the IM Workplan and documented in the May 27, 2022 Sediment and Porewater Sampling technical memorandum.

5.1.1 Mobilization

The Evergreen sampling team will travel by an 18-foot Jon boat equipped with a davit and winch (used as the sampling platform for all locations) to the AOI 7 shoreline area from a docking area located underneath the Commodore Barry Bridge near Subaru Park in Chester, Pennsylvania. The Jon boat drafts less than one foot of water which allows for access to shallow areas during low tide. The boat will be positioned as close as possible (within 2 feet) to the proposed location coordinates (as shown on Figure 18) using an on-board survey instrumentation (Trimble GeoXH) and the GPS-determined coordinates recorded for each location. For the first row of samples (PW-01B, PW-04B, PW-07B, PW-10B, PW-13B, PW-16B), each location will be evaluated by navigating to the coordinates for each location and then physically verifying with one of the samplers walking on the sediment surface to identify the rip rap and the toe of slope (and a soft bottom sediment area) to ensure that the sample is located immediately at the toe of the slope. If the sample location is not located at the toe of the slope, its distance from the toe of the slope will be noted. After positioning the boat and documenting the coordinates, the boat bow will anchor, and the sampling will take place off the side on the aft deck.

A stability plate will be used as part of the push point sampler so that the push point sampler will not move when deployed from the boat, since the tubing and wave action could potentially pull it loose. High and low tides hours will be researched and conveyed to the sampling team before the event. During areas of low tide, the first row of samples may not be reachable due to no standing water present. Sampling during high tide conditions (between five and six feet of standing water) can be conducted at any of the sampling locations because the push point sampler is able to reach these depths easily.

5.1.2 Porewater Sampling Methodology

Six-foot long push point samplers (used during the Evergreen, USACE and DVW sampling events) will be used for sample collection due to the anticipated tidal range. The porewater sampler will attach to a stability plate at approximately 0.5 ft from the bottom of the sampling probe. A retrieval line will be attached to the plate and the top of the probe so the sampler can be pulled aboard after the sampling. The probe will be lowered to the bottom and relocated as necessary to permit the stability plate to rest firmly on the bottom sediment. The interior probe placement rod is then removed and replaced with flexible tubing at the top of the probe and connected to the peristaltic pump for porewater collection. New tubing will be used at each location and the push point will be decontaminated using water, nitric acid and acetone followed by a final water rinse.

During the Evergreen 2022 porewater sampling event, additional actions were taken to retrieve a porewater sample as described below:

- Sampling at varying depths within a 0.2 to 0.8 ft interval,
- Sampling within a 20-ft radius of the original proposed location,
- Using up to five 0.45 micron filters per sample, since these locations had silt-laden porewater recovery that clogged the filters,
- Collection of samples that were less than the 150 mL originally requested for laboratory analysis of dissolved arsenic were collected,
- Taking out the screen in the push point sampling port, and
- Allowing for very slow porewater recovery (up to 20 minutes).

These additional actions may be taken during this additional porewater sampling event in the case that the push point sampler continues to be challenging to extract a porewater sample upon first attempt at each location.

The first step of the porewater sampling process will be to measure water quality parameters using a Myron Ultrameter Model 6P meter (Myron) to obtain field readings for conductivity, oxidation-reduction potential (ORP), pH and temperature. These water quality parameters will be collected at least once for every location to verify that the sample represents porewater, not surface water. The Myron meter will be calibrated each morning of the sampling event.

A 0.45 micron filter will be attached to the end of the tubing after water quality parameters are assessed, and a new filter will be used for each location. The dissolved arsenic porewater samples will be preserved in 250 mL nitric acid preserved bottles.

Porewater samples will be sent to SGS North America, Inc. (SGS) of Dayton, New Jersey for analysis of dissolved arsenic via USEPA SW-846 method 6010. One rinsate equipment blank will be collected for dissolved arsenic analysis following the decontamination process of the push point sampler. Additional field Quality Assurance/Quality Control (QA/QC) samples will include one field duplicate sample and one matrix spike/matrix spike duplicate (MS/MSD pair) from one of the porewater sampling locations collected. Data validation will be performed for all porewater samples collected for dissolved arsenic analysis.

5.2 Schedule

The additional porewater sampling is planned for October 24, 2022 through October 28, 2022 by Sanborn Head with their subcontractor Normandeau. After porewater sample results have been analyzed and data validated, the results of the confirmatory porewater sampling event will be provided in a subsequent IM Monthly Progress Report.

CSS/CC: css

Enclosures

IN-TEXT FIGURES

Figure 4.3A Shallow Groundwater Elevation over Time from September 19, 2022

Transducer Data
Figure 4.3B Deep Groundwater Elevation over Time from September 19, 2022 Transducer Data

FIGURES

Figure 1 AOI 7 Site Map
Figure 2 Dissolved Arsenic in Porewater Results
Figure 3 Arsenic in Sediment Results
Figure 4 Updated AOI 7 Site Plan
Figure 5 Cross Section Location Map
Figure 6 Cross Sections A-A' and C-C'
Figure 7 Cross Section B-B'
Figure 8 Shallow Groundwater Contours – High Tide, September 19, 2022
Figure 9 Shallow Groundwater Contours – Low Tide, September 19, 2022
Figure 10 Deep Groundwater Contours – High Tide, September 19, 2022
Figure 11 Deep Groundwater Contours – Low Tide, September 19, 2022
Figure 12 Distribution of Arsenic in Soil and Sediment
Figure 13 Cross Sections A-A and C-C' with Arsenic Concentrations
Figure 14 Cross Section B-B' with Arsenic Concentrations
Figure 15 Distribution of Dissolved Arsenic in Groundwater and Porewater
Figure 16 Conceptual Model Figure – Deep High Tide
Figure 17 Conceptual Model Figure – Deep Low Tide
Figure 18 Proposed Supplemental Porewater Sampling Locations

Table 1 IM Workplan Soil Data
Table 2 IM Workplan Groundwater Data
Table 3 IM Workplan Sediment Data
Table 4 IM Workplan Porewater Data

ATTACHMENTS

Attachment A Historic Areal Maps (from IM Workplan)
Attachment B Graph of Transducer Data and Borescope Data
Attachment C Arsenic Mass Discharge Calculations

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TABLES

Table 1
IM Workplan Soil Data
AOI 7, Marcus Hook Industrial Complex (MHIC)

Sample Location	Sample Date	Sample Type	Start Depth (ft)	End Depth (ft)	Arsenic		Iron	
					mg/kg		mg/kg	
				USEPA RSLs	**3**		**82,000**	
AOI7-BH-22-001	4/4/2022	N	0	5	<4.4		32,300	J
	4/4/2022	N	5	10	**9.2**		17,700	J
	4/4/2022	N	10	15	**6.9**		12,400	J
	4/4/2022	N	15	20	**12.6**		27,900	J
	4/4/2022	N	20	25	**8,270**		23,600	J
	4/4/2022	N	25	30	**1,310**		32,200	J
MW-559D	5/11/2022	N	0	5	**473**	J	**100,000**	
	5/11/2022	N	5	10	**422**	J	**192,000**	
	5/11/2022	N	10	15	**9,890**	J	50,500	
	5/11/2022	N	15	20	**719**	J	**158,000**	
	5/11/2022	N	20	25	**1,770**	J	37,700	
	5/11/2022	N	25	30	**12.2**	J	31,300	
MW-560D	5/11/2022	N	0	5	**239**	J	47,000	
	5/11/2022	N	5	10	**2,890**	J	**101,000**	
	5/11/2022	N	10	15	**6,940**	J	16,300	
	5/11/2022	N	15	20	**10,800**	J	30,500	
	5/11/2022	N	20	25	**488**	J	37,900	
	5/11/2022	N	25	30	**105**	J	16,900	
MW-608D	4/4/2022	N	0	5	**85.2**		34,800	J
	4/6/2022	N	5	10	**38.3**		23,700	
	4/6/2022	N	10	15	**33.4**		24,600	
	4/6/2022	N	15	20	**21.1**		37,200	
	4/6/2022	FD	15	20	**27.3**		43,800	
	4/6/2022	N	20	25	**10.7**		21,000	
	4/6/2022	N	25	30	**112**		28,000	
	4/6/2022	N	30	35	**14,800**		18,800	
	4/6/2022	N	35	40	**10,900**		24,100	
MW-609D	4/4/2022	N	0	5	**153**		34,600	J
	4/5/2022	N	5	10	**9.3**		16,800	J
	4/5/2022	N	10	15	**13.8**		30,300	J
	4/5/2022	N	15	20	**409**		74,700	J
	4/5/2022	N	20	25	**5.8**		16,200	J
	4/5/2022	N	25	30	**399**		**144,000**	**J**
	4/5/2022	N	30	35	**10,400**		24,400	J
	4/5/2022	N	35	40	**1,330**		26,600	J
Equipment Blank (mg/L)	4/6/2022	EB	–	–	<0.003		<0.1	

Notes:
1. Samples were collected by Sanborn Head personnel on the dates indicated and were analyzed by SGS North America, Inc. (SGS) of Dayton, New Jersey for arsenic by United States Environmental Protection Agency (USEPA) Method 6010D. A sample type of "N" indicates a normal sample. A sample type of "FD" indicates a field duplicate sample. A sample type of "EB" indicates an equipment blank sample.

2. "USEPA RSLs" are the USEPA Regional Screening Levels (TR=1e-6, THQ=0.1) for industrial soils (May 2022 - https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables).

3. **Bolded** values indicate an exceedance of the USEPA RSL.
"<" indicates the analyte is not detected above laboratory reporting limits.
"ft" indicates feet.
"J" indicates the result is estimated and may have an indeterminate bias.
"NS" indicates no standard.
"mg/kg" indicates milligrams per kilogram.
"mg/L" indicates milligrams per liter.

4. Data validation was performed on the samples provided in this table by Environmental Standards, Inc. of Valley Forge, Pennsylvania. All results are considered acceptable, with the understanding of the potential uncertainty (bias) in the qualified results. In some cases, Environmental Standards assigned the qualifiers noted above to the data. Refer to the Data Validation Summary Reports for further details.

Table 2
IM Workplan Groundwater Data
AOI 7, Marcus Hook Industrial Complex (MHIC)

Location	Sample Date	Sample Type	Arsenic µg/L	Iron µg/L
USEPA MCL			**10**	**NS**
Groundwater PRG			**1,253**	**NS**
MW-531L	5/25/2022	N	**202,000**	45,600
MW-532L	5/25/2022	N	**1,430,000**	60,300
MW-532L	5/25/2022	FD	**1,380,000**	51,700
MW-559D	5/26/2022	N	**297**	41,500
MW-560D	5/26/2022	N	**14,600**	52,800
MW-56D	5/25/2022	N	**386,000**	115,000
MW-606D	5/25/2022	N	**636,000**	319,000
MW-607D	5/26/2022	N	**111,000**	56,500
MW-608D	5/24/2022	N	**494,000**	73,600
MW-609D	5/24/2022	N	**633,000**	108,000
Equipment Blank	5/26/2022	EB	**11.3**	<100

Notes:
1. Samples were collected by Sanborn Head personnel on the dates indicated and were analyzed by SGS North America, Inc. (SGS) of Dayton, New Jersey for dissolved arsenic and iron by United States Environmental Protection Agency (USEPA) Method 6010D. A sample type of "N" indicates a normal sample. A sample type of "FD" indicates a field duplicate sample. A sample type of "EB" indicates an equipment blank sample.

2. "USEPA MCL" are from the United States Environmental Protection Agency (EPA) website. The Maximum Contaminant Level (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are enforceable standards for drinking water systems.

3. "Groundwater PRG" is the preliminary remediation goal (PRG) for dissolved arsenic in groundwater developed by Honeywell International, Inc. (Honeywell) for the protection of porewater.

4. **Bolded** values indicate an exceedance of the USEPA MCL.
Gray shaded values indicate an exceedance of the Groundwater PRG.
"<" indicates the analyte is not detected above laboratory reporting limits.
"NS" indicates no standard.
"µg/L" indicates micrograms per liter.

5. Data validation was performed on the samples provided in this table by Environmental Standards, Inc. of Valley Forge, Pennsylvania. All results are considered acceptable. Refer to the Data Validation Summary Reports for further details.

Table 3
IM Workplan Sediment Data
AOI 7, Marcus Hook Industrial Complex

Sample Location	Sample Date	Sample Type	Concentrations in mg/kg
			Arsenic
Arsenic in Sediment PRG			**170**
SED-01	03/22/22	N	102
SED-04	03/22/22	N	**353**
SED-05	03/22/22	N	92.6
SED-07	03/22/22	N	92.3 J
SED-07	03/22/22	FD	52.9 J
SED-10	03/22/22	N	60.2
SED-13	03/23/22	N	**198**
SED-14	03/23/22	N	18.7
SED-16	03/23/22	N	**227**
SED-17	03/24/22	N	15.6
SED-19	03/23/22	N	62.6
SED-22	03/23/22	N	87.8
SED-25	03/22/22	N	132
SED-28	03/22/22	N	41.0
Equipment Blank (ug/L)	03/24/22	EB	<3.0

Notes:
1. Samples were collected by Sanborn Head personnel on the dates indicated and were analyzed by SGS North America, Inc (SGS) of Dayton, New Jersey for metals by USEPA Method 6010D. A sample type of "N" indicates a normal sample. A sample type of "FD" indicates a field duplicate sample. A sample type of "EB" indicates an equipment blank sample.

2. **Bolded** values indicate an exceedance of the arsenic in sediment preliminary remediation goal (PRG).This PRG was developed by Honeywell International, Inc. (Honeywell) for the protection of sediment.

"<" indicates the analyte is not detected above laboratory reporting limits.

"J" indicates the result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

"ug/L" indicates micrograms per liter.

"mg/kg" indicates milligrams per kilogram.

3. Data validation was performed on the samples provided in this table by Environmental Standards, Inc of Valley Forge, Pennsylvania. All results were considered acceptable, with the understanding of the potential uncertainty (bias) in the qualified results. In some cases, Environmental Standards assigned the qualifiers noted above to the data. Refer to the Data Validation Summary Reports for further details.

Table 4
IM Workplan Porewater Data
AOI 7, Marcus Hook Industrial Complex

Sample Location	Sample Date	Sample Type	Dissolved Arsenic (ug/L)
Groundwater PRG (ug/L)			**1,253**
PW-04	03/24/22	N	442
PW-09	03/25/22	N	10.7
PW-11	03/23/22	N	<3.0
PW-13	03/24/22	N	276
PW-14	03/24/22	N	47.6
PW-16	03/23/22	N	7.7
PW-17	03/24/22	N	71.5
PW-20	03/24/22	N	69.3
	03/24/22	FD	75.7
PW-24	03/25/22	N	32.7
PW-25	03/25/22	N	178
PW-27	03/25/22	N	11
Equipment Blank	03/25/22	EB	<3

Notes:

1. Samples were collected by Sanborn Head personnel on the dates indicated and were analyzed by SGS North America, Inc. (SGS) of Dayton, New Jersey for dissolved arsenic by USEPA Method 6010D. A sample type of "N" indicates a normal sample. A sample of "FD" indicates a field duplicate. A sample type of "EB" indicates an equipment blank sample.

2. The "Groundwater PRG" is a preliminary remediation goal (PRG) for dissolved arsenic in groundwater developed by Honeywell International, Inc. (Honeywell) for the protection of porewater.

3. "<" indicates the analyte is not detected above laboratory reporting limits. "ug/L" indicates micrograms per liter.

4. Data validation was performed on the samples provided in this table by Environmental Standards, Inc of Valley Forge, Pennsylvania. All results were considered acceptable, with the understanding of the potential uncertainty (bias) in the qualified results. Refer to the Data Validation Summary Reports for further details.

FIGURES

Figure 1

AOI 7 Site Map

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	H. Pothier
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	December 2021

Notes

1. AOI 7 well locations provided by Stanport data portal, August 2021.

2. Aerial imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

3. SWMU 9 located based on SWMU 9 Data Summary Report, Wood, 2020.

4. The bulkhead, remedial systems sheet pile wall and well locations were provided by Stantec in Figure I-3 “Phillips Island Remediation System Site Plan” from July 2019.

Legend

- Monitoring Well
- Recovery Well
- Soil Boring
- Staff Gauge
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary

137.5 68.75 0 137.5 275 Feet

SANBORN HEAD

Figure 2

Dissolved Arsenic in Porewater Results

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	M. Fuerte
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.04
Date:	May, 2022

Notes

1. AOI 7 well locations provided by Stanport data portal, August 2021.

2. Aerial imagery sourced from Pennsylvania Spatial Data Access, 2018 - 2020 - Pennsylvania Emergency Management Agency Orthoimagery.

3. SWMU 9 located based on SWMU 9 Data Summary Report, Wood, 2020.

4. USACE 2 through USACE 9 porewater sample locations were taken from the coordinates provided in Table 1 under "USACE Coordinates" of the January 2019 "Delaware Valley Works Pore Water Sampling Event" by the U.S. Army Corps of Engineers. USACE 1 coordinates were not provided in this document because a sample was not taken at this location. These locations are represented by circles.

5. DVW-16-001 through DVW-16-010 are dual sediment and porewater locations that were taken from the coordinates provided in Figure 1 of the March 2017 "Supplemental Pathway Investigation Results Report" by Anchor QEA, LLC. These locations are represented by diamonds.

6. PW-01 through PW-30 are porewater samples collected by Evergreen in March 2022 via peristaltic pump. These locations are represented by squares.

7. Sunoco offshore pipeline georeferenced from "Supplemental Study Area Sediment Investigation Report, Delaware Works Property". Location is approximate.

8. The bulkhead, remedial systems, sheet pile wall and well locations were provided by Stantec in Figure I-3 "Phillips Island Remediation System Site Plan" from July 2019.

9. "NS" indicates a location was not sampled via peristaltic pump.

10. All concentrations in ug/L.

11. The preliminary remediation goal (PRG) for arsenic in groundwater is 1253 ug/L.

Legend (continued)

- Monitoring Well
- Recovery Well
- Remediation Well
- Soil Boring
- Staff Gauge
- Historic Arsenic in Groundwater Above 1,253 ug/L
- Sunoco Pipeline
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary

Legend

- $_{12}$ Evergreen 2022 porewater sample, arsenic result (ug/L) below 1253 ug/L
- $_{NS}$ Evergreen 2022 porewater sample not collected via peristaltic pump
- $_{12}$ USACE 2018 porewater sample, arsenic result (ug/L) below 1253 ug/L
- $_{1500}$ USACE 2018 porewater sample, arsenic result (ug/L) above 1253 ug/L
- $_{NS}$ USACE 2018 porewater sample not analyzed for dissolved arsenic
- $_{12}$ DVW 2016 porewater sample, arsenic result (ug/L) below 1253 ug/L
- $_{1500}$ DVW 2016 porewater sample, arsenic result (ug/L) above 1253 ug/L

137.5 68.75 0 137.5 275 Feet

SANBORN HEAD

Figure 3

Arsenic in Sediment Results

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	M. Fuerte
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.04
Date:	May, 2022

Notes

1. AOI 7 well locations provided by Stanport data portal, August 2021.

2. Aerial imagery sourced from Pennsylvania Spatial Data Access, 2018 - 2020 - Pennsylvania Emergency Management Agency Orthoimagery.

3. SWMU 9 located based on SWMU 9 Data Summary Report, Wood, 2020.

4. DVW-16-001 through DVW-16-010 are dual sediment and porewater locations that were taken from the coordinates provided in Figure 1 of the March 2017 “Supplemental Pathway Investigation Results Report” by Anchor QEA, LLC. These locations are represented by diamonds.

5. SED-01 through SED-30 are sediment samples collected by Evergreen in March 2022. These locations are represented by squares.

6. Sunoco offshore pipeline georeferenced from "Supplemental Study Area Sediment Investigation Report, Delaware Works Property". Location is approximate.

7. The bulkhead, remedial systems, sheet pile wall and well locations were provided by Stantec in Figure I-3 “Phillips Island Remediation System Site Plan” from July 2019.

8. "NA" indicates a sample was collected in the field but not analyzed.

9. The preliminary remediation goal (PRG) for arsenic in sediment is 170 mg/kg.

Legend (continued)

- Monitoring Well
- Recovery Well
- Remediation Well
- Soil Boring
- Staff Gauge
- Historic Arsenic in Groundwater Above 1,253 ug/L
- Sunoco Pipeline
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary

Legend

- 12 — Evergreen 2022 sediment sample, arsenic result (mg/kg) below 170 mg/kg
- 200 — Evergreen 2022 sediment sample, arsenic result (mg/kg) above 170 mg/kg
- NA — Evergreen 2022 sediment sample, field sample collected but not analyzed
- 12 — DVW 2016 sediment sample, arsenic result (mg/kg) below 170 mg/kg
- 200 — DVW 2016 sediment sample, arsenic result (mg/kg) above 170 mg/kg

137.568.75 0 137.5 275 Feet

SANBORN HEAD

Figure 4

Updated AOI 7 Site Plan

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	M. Fuerte / E. Wright
Designed By:	C. Costello
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. AOI 7 well locations provided by Stanport data portal, August 2021.

2. Aerial imagery Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

3. SWMU 9 located based on SWMU 9 Data Summary Report, Wood, 2020.

4. The bulkhead, remedial systems, sheet pile wall and well locations were provided by Stantec in Figure I-3 "Phillips Island Remediation System Site Plan" from July 2019.

Legend

- Monitoring Well
- Recovery Well
- Remediation Well
- Soil Boring
- Staff Gauge
- 2022 Monitoring Well
- 2022 Soil Boring
- Existing Location for PDI Sampling and Pressure Transducer
- Existing Location for PDI Sampling Only
- Sunoco Pipeline
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary

137.568.75 0 137.5 275 Feet

SANBORN HEAD

Last Edited By: hlapointe

Path: P:\4800s\4862.00\Graphics Files\ArcGIS\Figures\202107 AOI Interim Workplan\XSectLoc.mxd

Figure 5

Cross Section Location Map

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	December 2021

Notes

1. AOI 7 well locations provided by Stanport data portal, August 2021.

2. Aerial imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

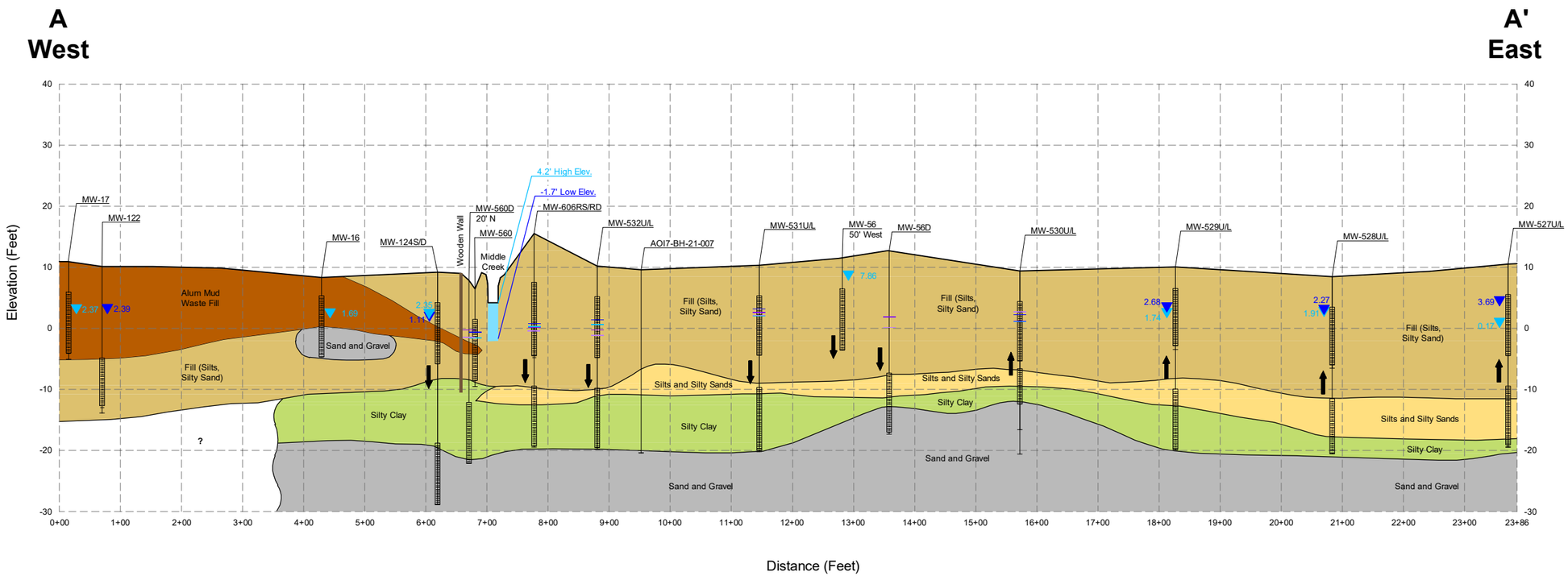
3. SWMU 9 located based on SWMU 9 Data Summary Report, Wood, 2020.

Legend

- Monitoring Well
- Recovery Well
- Remediation Well
- Soil Boring
- Staff Gauge
- A — A' Cross Section

137.5 68.75 0 137.5 275 Feet

SANBORN HEAD



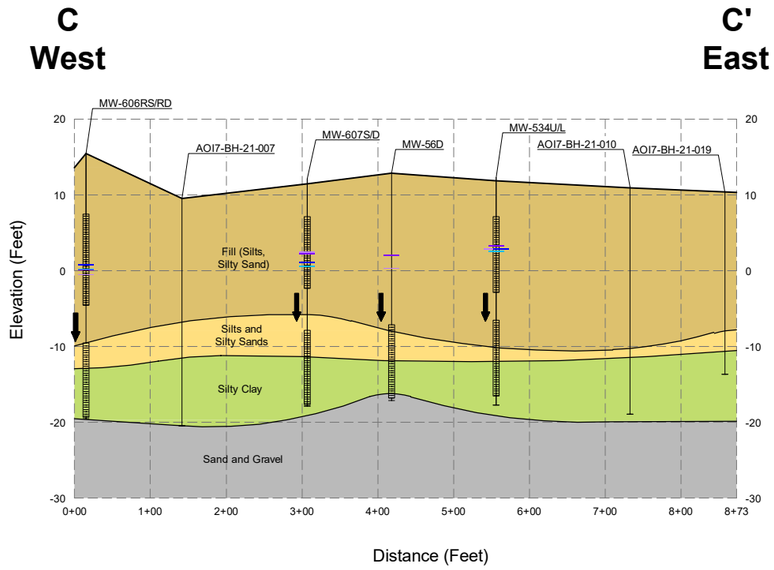


Figure 6

Cross Sections A-A' and C-C'

Evergreen
Marcus Hook, Pennsylvania

Drawn By: E. Wright
Designed By: C. Shepsko
Reviewed By: C. Costello
Project No: 4862.00
Date: September 2022

Notes

1. 2021 boring logs provided in Appendix D of the 2021 IM Work Plan. RFI boring logs are in the RFI (GHD 2017, revised 2019). Logs for the 2022 borings will be provided in a future submittal.

2. SWMU 9 topography from Supplemental Pathway Investigation Results Report (AMEC Foster Wheeler, 2017).

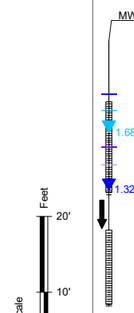
3. Bottom elevation of Middle Creek surveyed in May 2021 by Vargo Associates using the NAVD 1988 vertical datum in US Feet.

4. Groundwater elevations shown with the triangle symbology are from August 18, 2021. Updated high and low tide groundwater elevations denoted by the purple and blue lines in the legend are from September 19, 2022.

5. Water elevations shown for Middle Creek were taken from the staff gauge in Middle Creek on September 19, 2022 high tide and low tide conditions.

6. SWMU 9 geology based on boring logs in SWMU 9 Data Summary Report (Wood, 2020) and Cross Sections in Supplemental Pathway Investigation Results Report (AMEC Foster Wheeler, 2017).

Legend

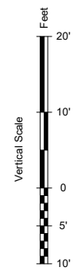


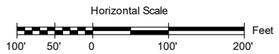
Well ID

Shallow high tide groundwater elevation
Shallow low tide groundwater elevation
Shallow groundwater elevation
Deep high tide groundwater elevation
Deep low tide groundwater elevation
Deep groundwater elevation

Hydraulic gradient direction

Well screen





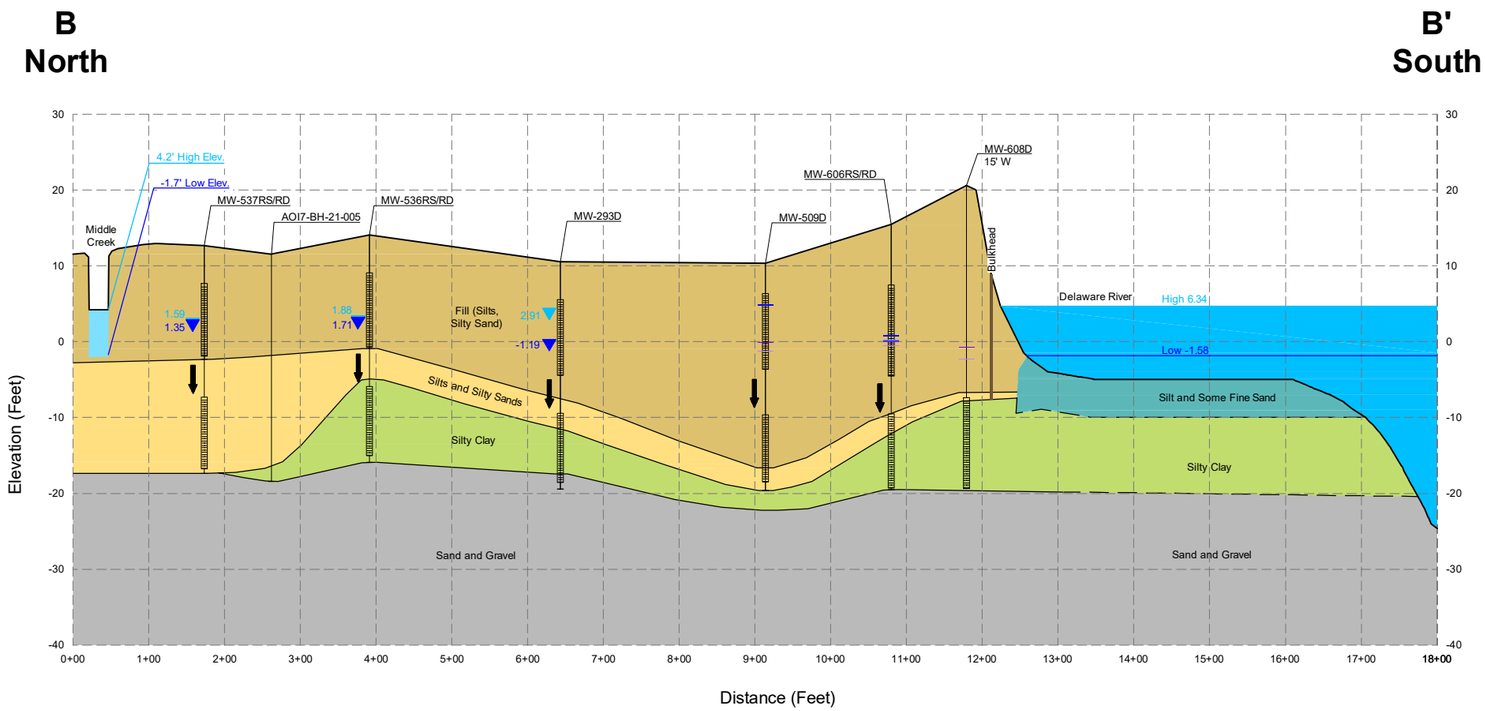
SANBORN HEAD

Figure 7

Cross Section B-B'

Evergreen
Marcus Hook, Pennsylvania

Drawn By: E. Wright
Designed By: C. Shepsko
Reviewed By: C. Costello
Project No: 4862.00
Date: September 2022



Notes

1. 2021 boring logs provided in Appendix D of the 2021 IM Work Plan. RFI boring logs are in the RFI (GHD 2017, revised 2019). Logs for the 2022 borings will be provided in a future submittal.

2. Bottom elevation of Middle Creek surveyed in May 2021 by Vargo Associates using the NAVD 1988 vertical datum in US Feet.

3. Groundwater elevations shown with the triangle symbology are from August 18, 2021. Updated high and low tide groundwater elevations denoted by the purple and blue lines in the legend are from September 19, 2022.

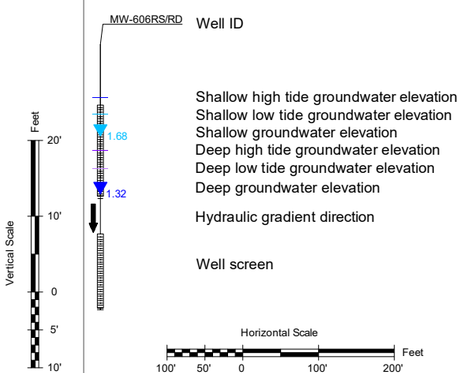
4. Water elevations shown for the Delaware River were taken from the USGS Station # 01482170 for the Delaware River at New Castle, DE for August 18, 2021.

5. Water elevations shown for Middle Creek were taken from the staff gauge in Middle Creek on September 19, 2022 at high tide and low tide conditions.

6. The Delaware River sediment lithology in the 0 to 5 ft below grade interval is based on sediment core logs from the January 17, 2020 Marcus Hook Industrial Complex Water Quality Certificate: January 2020 Sediment Sampling Results letter from Weston Solutions, Inc. The lithology below 5 ft below grade is projected from the lithology in AOI 7 and should be considered approximate.

7. The location of bulkhead is based on the Figure I-3 “Phillips Island Remediation System Site Plan” provided by Stantec from July 2019.

Legend



SANBORN HEAD

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Figure 8

Shallow Groundwater Contours - High Tide, September 2022

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The surface water location depicted in this figure is for evaluation purposes. The actual surface water location is on the Dock off the AOI 7 shoreline.

Legend

MW-531U
2.9
Location Name
Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour

100 50 0 100 200 Feet

SANBORN HEAD

Last Edited By: zsvoboda

Path: P:\4800s\4862.00\Graphics Files\ArcGIS\Figures\202209 GW Contours\Water_Levels.mxd

Figure 9

Shallow Groundwater Contours - Low Tide, September 2022

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The surface water location depicted in this figure is for evaluation purposes. The actual surface water location is on the Dock off the AOI 7 shoreline.

Legend

MW-531U — Location Name
1.76 — Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour

100 50 0 100 200 Feet

SANBORN HEAD

Figure 10

Deep Groundwater Contours - High Tide, September 19, 2022

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The surface water location depicted in this figure is for evaluation purposes. The actual surface water location is on the Dock off the AOI 7 shoreline.

Legend

MW-531L
2.12
Location Name
Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour

100 50 0 100 200 Feet

SANBORN HEAD

Last Edited By: zsvoboda

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Figure 11

Deep Groundwater Contours - Low Tide, September 2022

Evergreen

Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The surface water location depicted in this figure is for evaluation purposes. The actual surface water location is on the Dock off the AOI 7 shoreline.

Legend

MW-531L
1.68
Location Name
Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour

100 50 0 100 200 Feet

SANBORN HEAD

Figure 12

Distribution of Arsenic in Soil and Sediment

Evergreen
Marcus Hook, Pennsylvania

Drawn By:	H. LaPointe
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial imagery provided by Google Earth Pro. (May 2016). Claymont, Delaware USA. 39° 48' 24.73"N, 75° 25' 50.50"W, Eye alt 4289 feet. [November 2020].

2. Area between each set of composite soil sample locations indicates the representative area covered by composite samples. The max subsurface concentration, from all time, for each set of composite points is shown.

3. The maximum concentration from each boring are shown for each sample location.

4. SB-01, SB-02, SB-03, SB-04, SB-05, SB-06 on SWMU 9 are composite samples.

5. Historical arsenic and iron data originate from the 2017 AOI 7 RFI, 2020 SWMU 9 Data Summary Report, and 2017 Supplemental Pathway Investigation Results Report.

6. Samples were performed on 5/29/03, 5/30/03, 6/2/03, 6/4/03, 7/21/15, 7/29/15, 7/30/15, 8/3/15, 8/4/15, 8/6/15, 8/7/15, 8/12/15, 8/13/15, 8/18/15 - 8/21/15, 8/24/15 - 8/26/15, 1/4/16 - 1/7/16, 3/21/16, 9/30/19, 10/1/19, 10/3/19, 7/15/21, 7/16/21, 7/19/21, 7/20/21 - 7/22/21, and 7/27/21 - 7/29/21.

Legend

Subsurface Soil (mg/kg)

- <170
- 170 - 1,700
- 1,700 - 17,000

Sediment (mg/kg)

- <170
- 170 - 1,700
- 1,700 - 17,000

NA — Evergreen 2022 sediment sample, field sample collected but not analyzed

LNAPL Sample Location (mg/L)

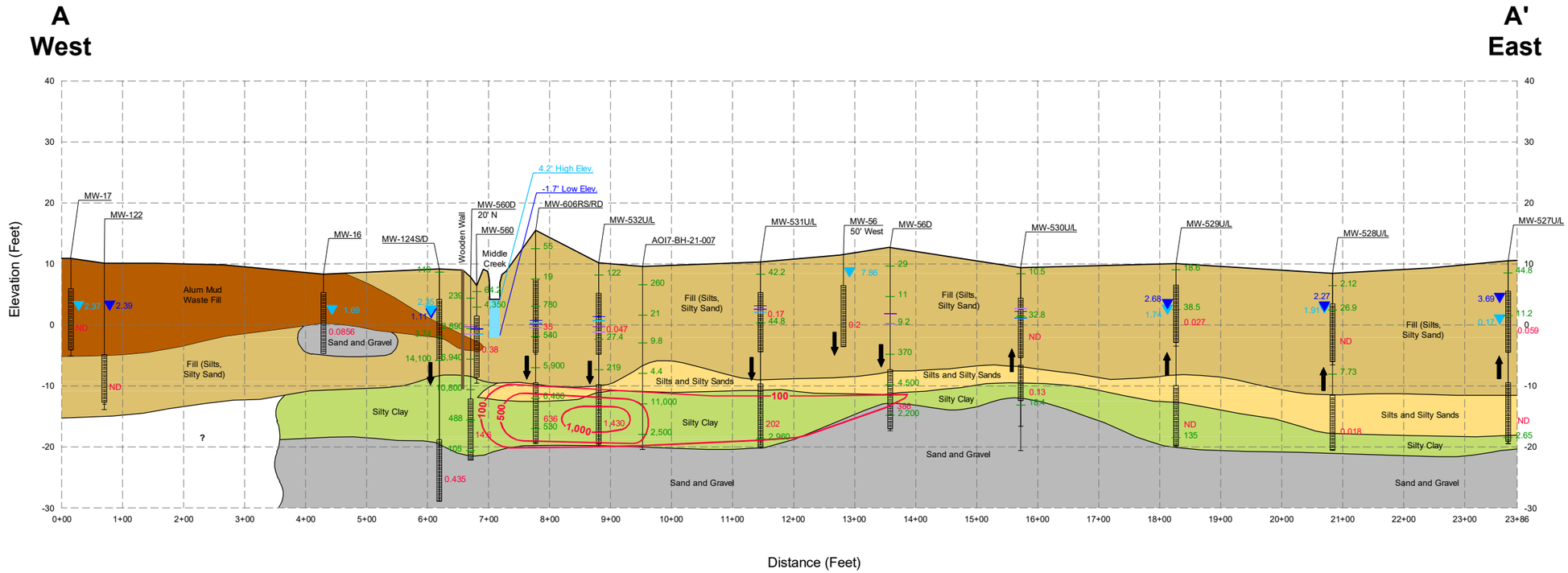
AOI 7 Boundary

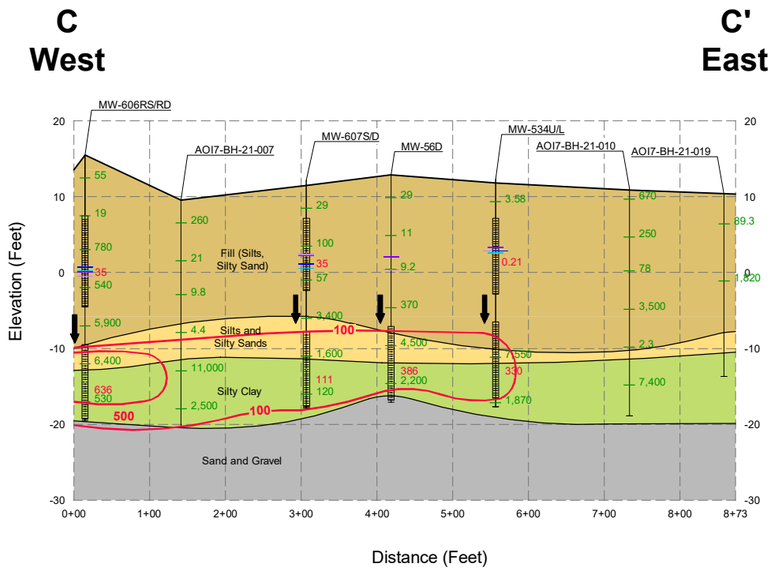
SWMU 9 Boundary

Arsenic in sediment preliminary remediation goal (PRG) is 170 mg/kg

125 62.5 0 125 250 Feet

SANBORN HEAD





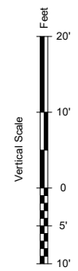


Figure 13

Cross Sections A-A' and C-C' with Arsenic Concentrations

Evergreen
Marcus Hook, Pennsylvania

Drawn By: E. Wright
Designed By: C. Shepsko
Reviewed By: C. Costello
Project No: 4862.00
Date: September 2022

Notes

1. 2021 boring logs provided in Appendix D of the 2021 IM Work Plan. RFI boring logs are in the RFI (GHD 2017, revised 2019). Logs for the 2022 borings will be provided in a future submittal.

2. SWMU 9 topography from Supplemental Pathway Investigation Results Report (AMEC Foster Wheeler, 2017).

3. Bottom elevation of Middle Creek surveyed in May 2021 by Vargo Associates using the NAVD 1988 vertical datum in US Feet.

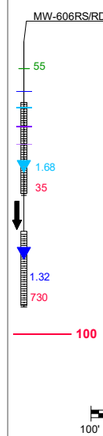
4. Groundwater elevations shown with the triangle symbology are from August 18, 2021. Updated high and low tide groundwater elevations denoted by the purple and blue lines in the legend are from September 19, 2022.

5. Water elevations shown for Middle Creek were taken from the staff gauge in Middle Creek on September 19, 2022 high tide and low tide conditions.

6. SWMU 9 geology based on boring logs in SWMU 9 Data Summary Report (Wood, 2020) and Cross Sections in Supplemental Pathway Investigation Results Report (AMEC Foster Wheeler, 2017).

7. Soil arsenic concentrations are from the 2017 RFI (GHD, 2017), July 2021, and April/May 2022 results. Groundwater concentrations are from the August 2021 and May 2022 results.

Legend



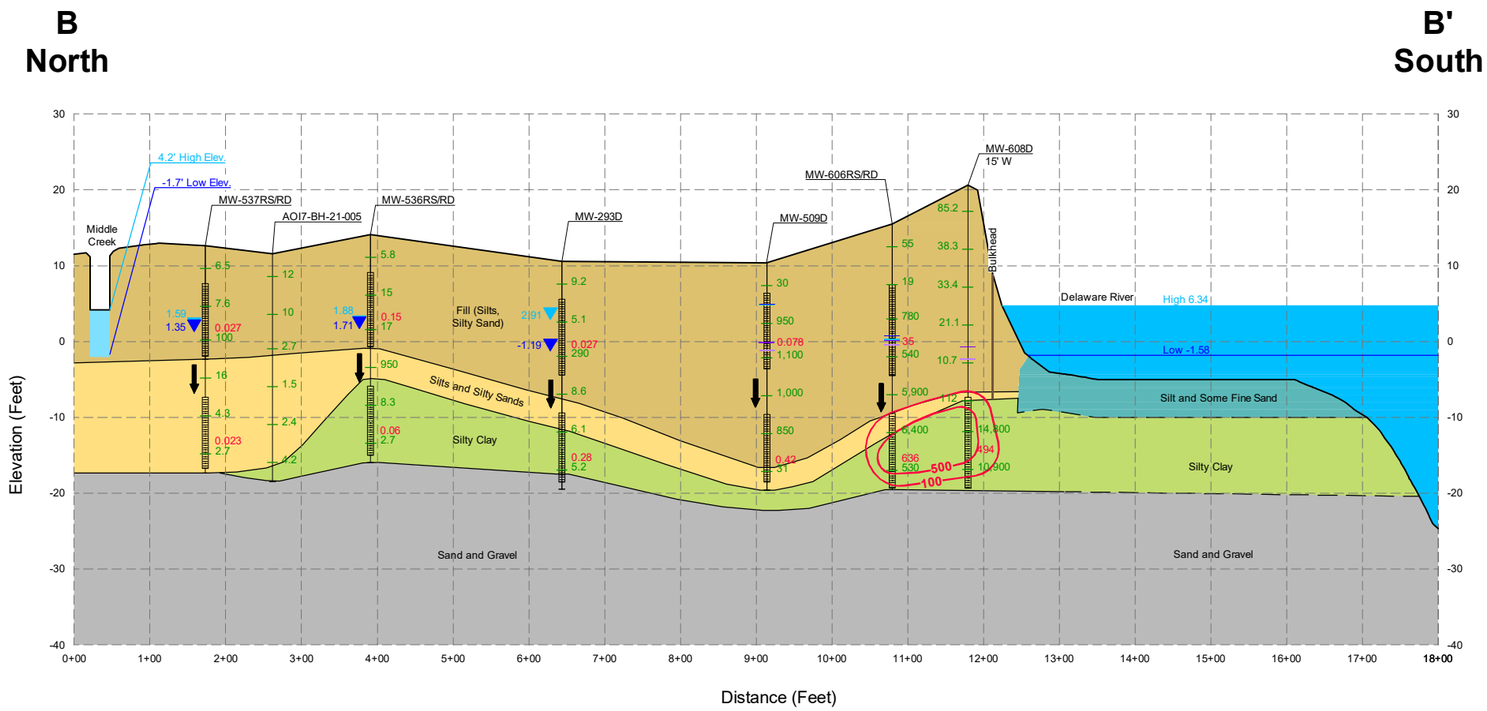
SANBORN HEAD

Figure 14

Cross Section B-B' with Arsenic Concentrations

Evergreen
Marcus Hook, PA

Drawn By: E. Wright
Designed By: C. Shepsko
Reviewed By: C. Costello
Project No: 4862.00
Date: September 2022



Vertical Scale: Feet 20' 10' 0 5' 10'

Legend

- MW-606RS/RD — Well ID
- 55 — Arsenic in soil at depth sampled (mg/kg)
- Shallow high tide groundwater elevation
- Shallow low tide groundwater elevation
- Deep high tide groundwater elevation
- Deep low tide groundwater elevation
- 1.68 — Shallow groundwater elevation
- 35 — Shallow Arsenic result in mg/L
- Hydraulic gradient direction
- Well screen
- 1.32 — Deep groundwater elevation
- 730 — Deep Arsenic result in mg/L
- 100 — Arsenic isopleth mg/L

Horizontal Scale: 100' 50' 0 100' 200' Feet

Notes

1. 2021 boring logs provided in Appendix D of the 2021 IM Work Plan. RFI boring logs are in the RFI (GHD 2017, revised 2019). Logs for the 2022 borings will be provided in a future submittal.

2. Bottom elevation of Middle Creek surveyed in May 2021 by Vargo Associates using the NAVD 1988 vertical datum in US Feet.

3. Groundwater elevations shown with the triangle symbology are from August 18, 2021. Updated high and low tide groundwater elevations denoted by the purple and blue lines in the legend are from September 19, 2022.

4. Water elevations shown for the Delaware River were taken from the USGS Station # 01482170 for the Delaware River at New Castle, DE for August 18, 2021.

5. Water elevations shown for Middle Creek were taken from the staff gauge in Middle Creek on September 19, 2022 at high tide and low tide conditions.

6. The Delaware River sediment lithology in the 0 to 5 ft below grade interval is based on sediment core logs from the January 17, 2020 Marcus Hook Industrial Complex Water Quality Certificate: January 2020 Sediment Sampling Results letter from Weston Solutions, Inc. The lithology below 5 ft below grade is projected from the lithology in AOI 7 and should be considered approximate.

7. The location of bulkhead is based on the Figure I-3 “Phillips Island Remediation System Site Plan” provided by Stantec from July 2019.

8. Soil arsenic concentrations are from the 2017 RFI (GHD, 2017), July 2021, and April/May 2022 results. Groundwater concentrations are from the August 2021 and May 2022 results.

SANBORN HEAD

Last Edited By: hlapointe

Path: P:\4800s\4862.00\Graphics Files\ArcGIS\Figures\202208 Figures\GW_PW_Arsenic_V2.mxd

Figure 15

Distribution of Dissolved Arsenic in Groundwater and Porewater

Evergreen, LLC

Marcus Hook, Pennsylvania

Drawn By:	M. Fuerte
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Figure Narrative

This figure shows the distribution of groundwater and porewater Arsenic (ug/L) across Honeywell SWMU-9 and Evergreen AOI-7 properties. The max concentration between 05/2003 and 10/2019 are shown for each sample location. Detected groundwater and porewater sample results shown exceeded the US EPA Maximum Contaminant Level (MCL) = 10 ug/L.

Notes

1. Aerial imagery provided by Google Earth Pro. (May 2016). Claymont, Delaware USA. 39° 48' 24.73"N, 75° 25' 50.50"W, Eye alt 4289 feet. [November 2020].

2. Concentrations for total Arsenic are shown, with the exception of SWMU-9 porewater (DVW-16-XX). The maximum dissolved arsenic concentration between the shallow and deep intervals are shown for these locations.

3. Grab samples collected from boring locations during Honeywell's Phase I RFI. Precise depths are unknown.

Legend

Monitoring Wells (ug/L)

- Not Detected (ND)
- <1,253
- 1,253 - 12,530
- 12,530 - 125,300
- 125,300 - 1,253,000
- > 1,253,000

Porewater (ug/L)

- Not Detected (ND)
- <1,253
- 1,253 - 12,530
- 12,530 - 125,300
- 125,300 - 1,253,000
- > 1,253,000

NS — Evergreen 2022 porewater sample not collected via peristaltic pump

Grab Samples (ug/L)

- <1,253
- 1,253 - 12,530
- 12,530 - 125,300
- 125,300 - 1,253,000
- > 1,253,000

- AOI 7 Boundary
- SWMU 9 Boundary

Arsenic in groundwater preliminary remediation goal (PRG) is 1,253 ug/L

100 50 0 100 200 Feet

SANBORN HEAD

Last Edited By: zsvoboda
Path: P:\4800s\4862.00\Graphics Files\ArcGIS\Figures\202209 GW Contours\ConceptualSiteModel.mxd

Figure 16

Conceptual Model Figure - Deep High Tide

Evergreen
Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The stilling well location depicted in this figure is for evaluation purposes. The actual stilling well location is on the Dock off the AOI 7 shoreline.

Legend

MW-531L
1.68
Location Name
Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour
- Current and Historic Arsenic in Groundwater Above 1,253 µg/L

- 12 Evergreen 2022 porewater sample, arsenic result (ug/L) below 1253 ug/L
- NS Evergreen 2022 porewater sample not collected via peristaltic pump
- 12 USACE 2018 porewater sample, arsenic result (ug/L) below 1253 ug/L
- 1500 USACE 2018 porewater sample, arsenic result (ug/L) above 1253 ug/L
- NS USACE 2018 porewater sample not analyzed for dissolved arsenic
- 12 DVW 2016 porewater sample, arsenic result (ug/L) below 1253 ug/L
- 1500 DVW 2016 porewater sample, arsenic result (ug/L) above 1253 ug/L

100 50 0 100 200 Feet

SANBORN HEAD

Last Edited By: zsvoboda
Path: P:\4800s\4862.00\Graphics Files\ArcGIS\Figures\202209 GW Contours\ConceptualSiteModel.mxd

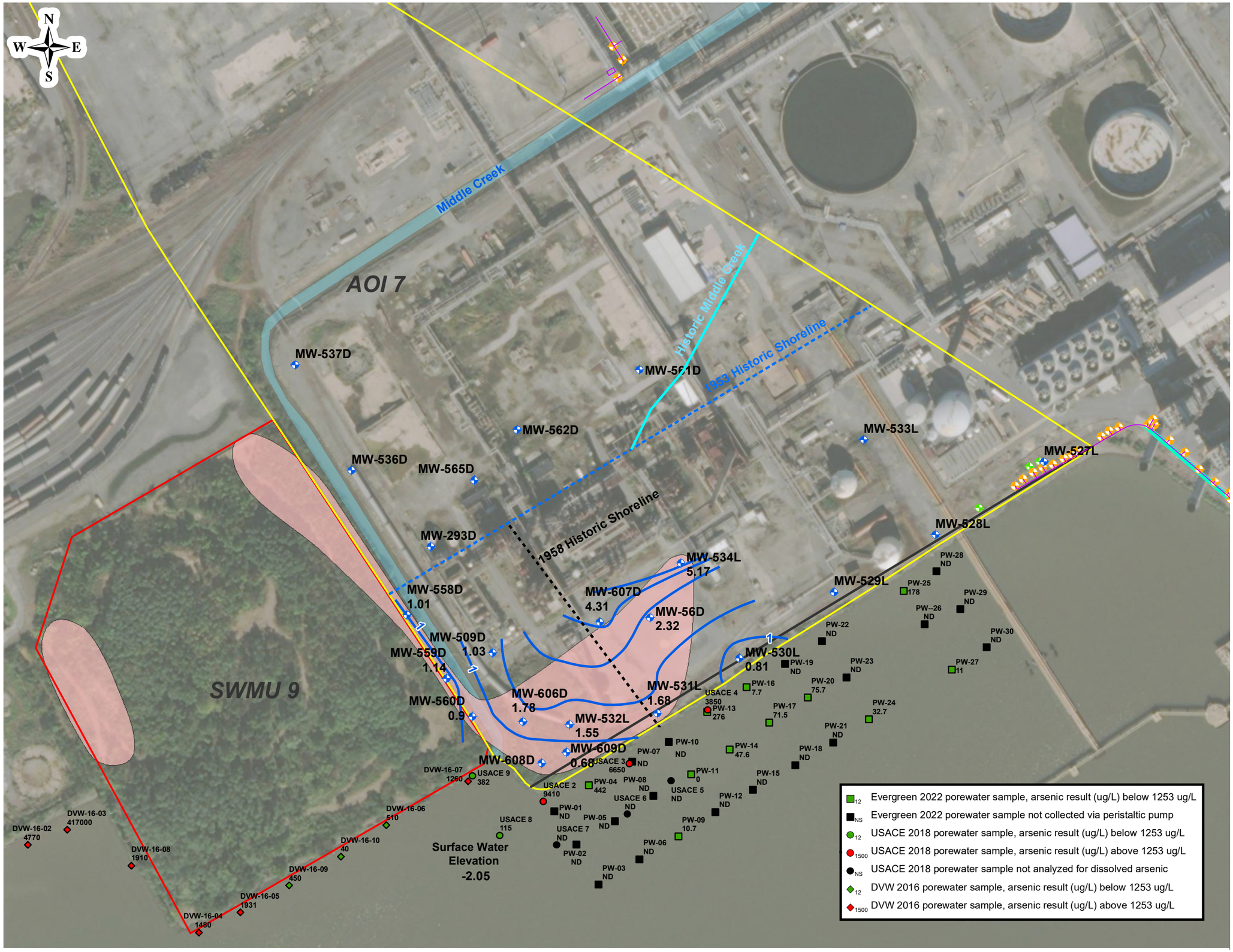


Figure 17

Conceptual Model Figure - Deep Low Tide

Evergreen
Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The stilling well location depicted in this figure is for evaluation purposes. The actual stilling well location is on the Dock off the AOI 7 shoreline.

Legend

MW-531L Location Name
1.68 Water Elevation (ft amsl)

- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour
- Current and Historic Arsenic in Groundwater Above 1,253 µg/L

100 50 0 100 200 Feet

SANBORN HEAD

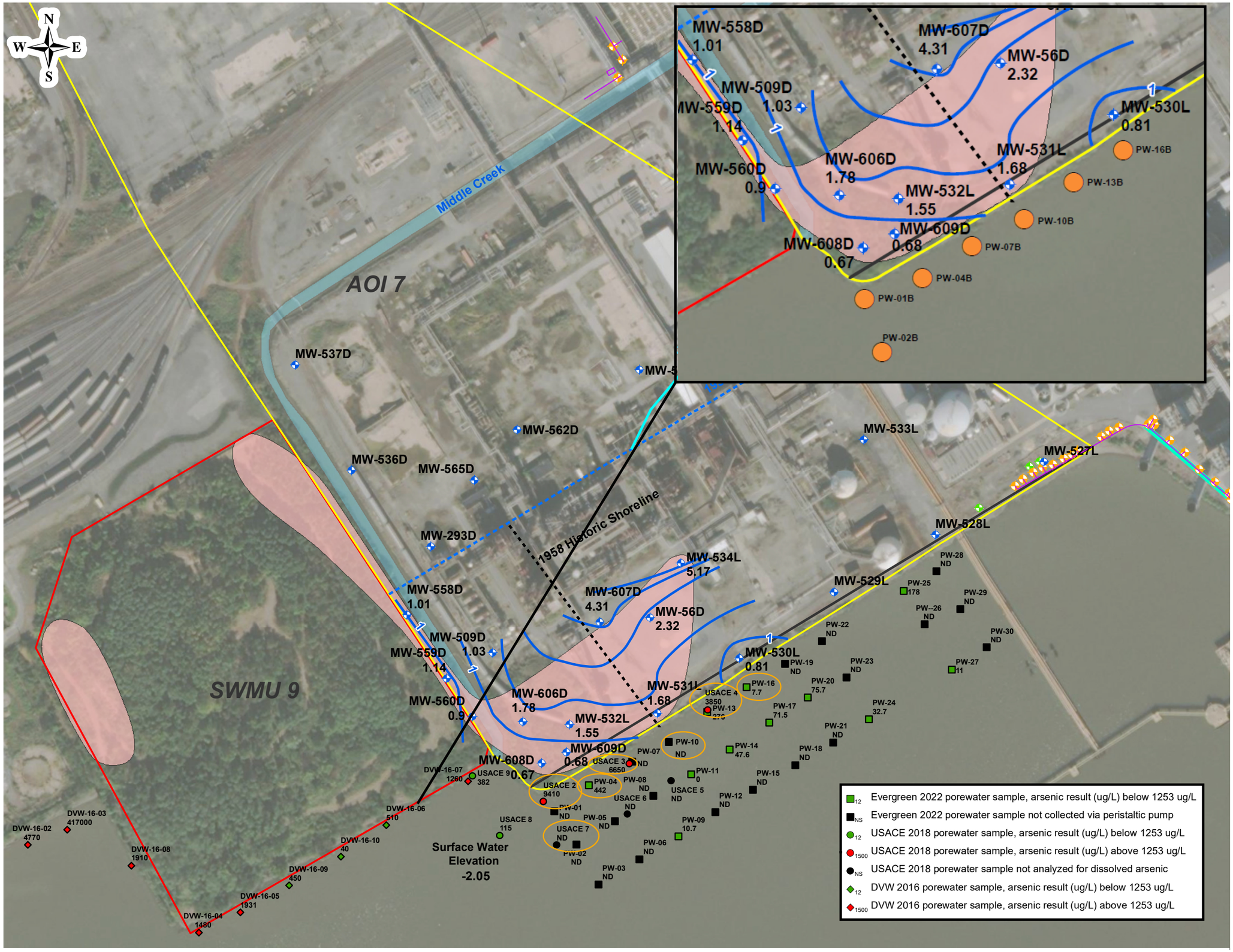


Figure 18

Proposed Supplemental Porewater Sampling Locations

Evergreen
Marcus Hook, Pennsylvania

Drawn By:	Z. Svoboda
Designed By:	C. Shepsko
Reviewed By:	C. Costello
Project No:	4862.00
Date:	September 2022

Notes

1. Aerial Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

2. Groundwater elevations were taken on September 19, 2022.

3. The stilling well location depicted in this figure is for evaluation purposes. The actual stilling well location is on the Dock off the AOI 7 shoreline.

Legend

MW-531L 1.68 Location Name, Water Elevation (ft amsl)

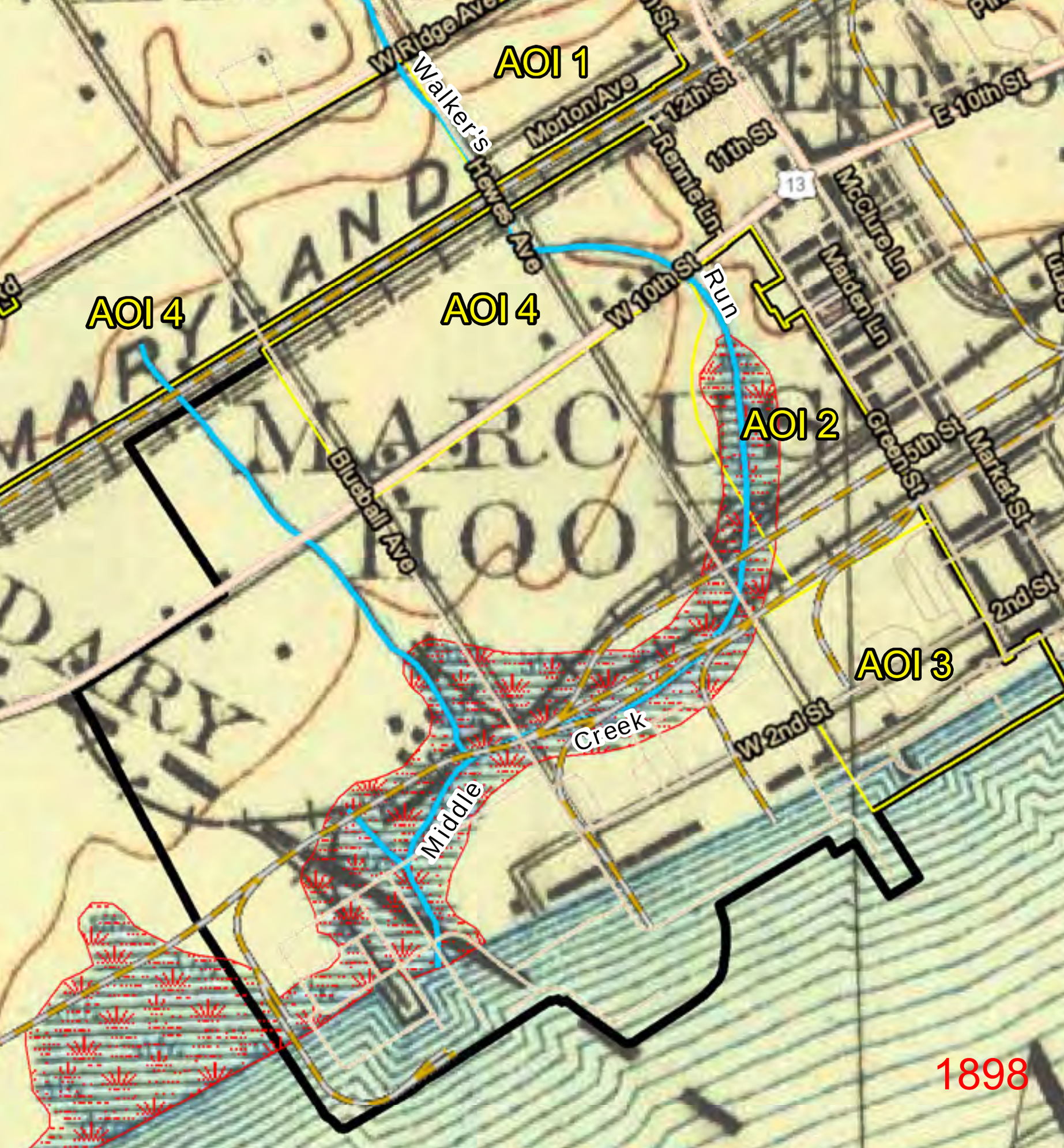
- Monitoring Well
- Recovery Well
- Remediation Well
- Bulkhead
- Sheet Pile Wall
- Remediation Systems
- AOI-7 Boundary
- SWMU 9 Boundary
- Groundwater Elevation Contour
- Current and Historic Arsenic in Groundwater Above 1,253 µg/L
- Proposed Porewater Sample Locations

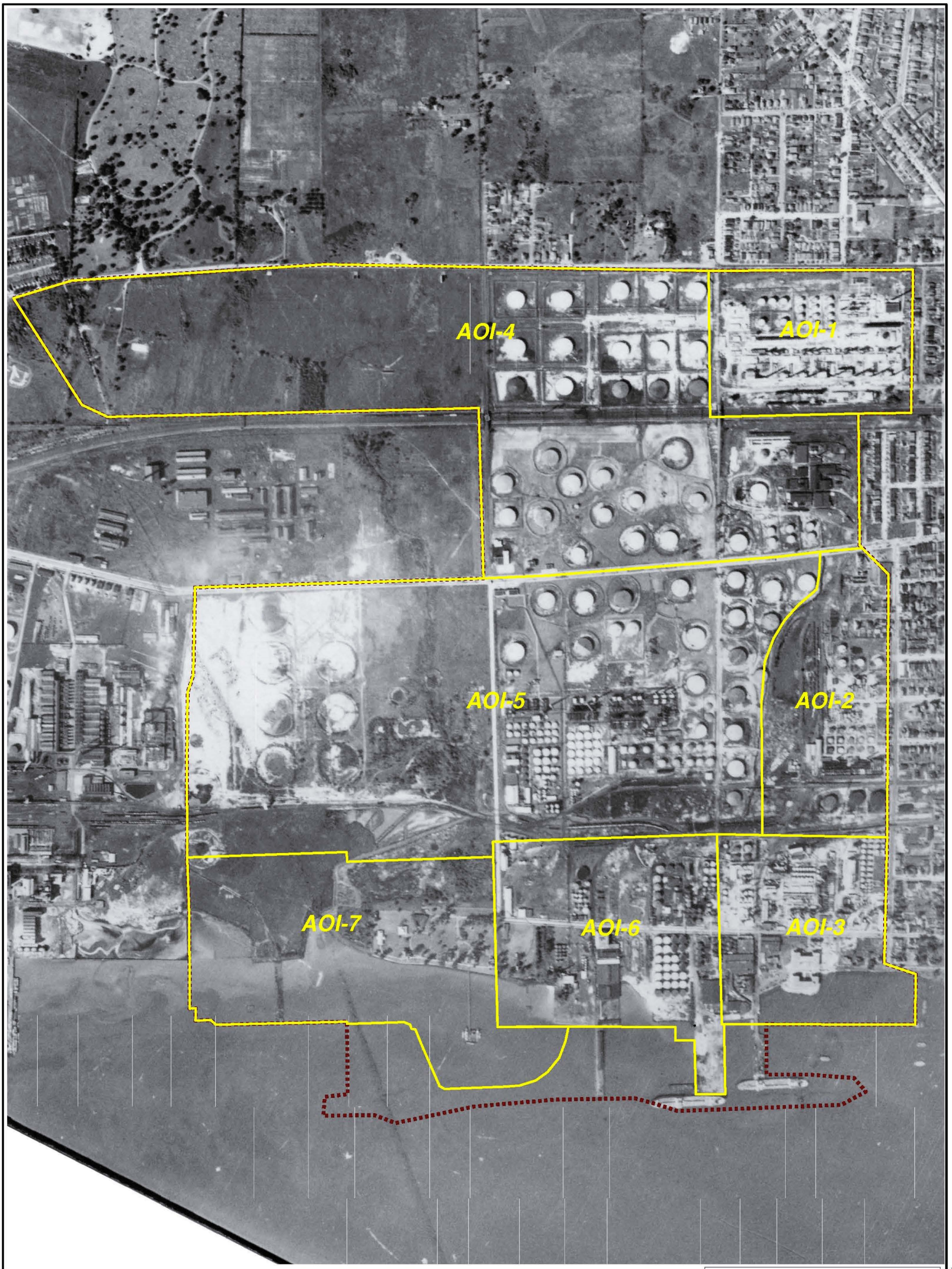
SANBORN HEAD

ATTACHMENTS

ATTACHMENT A

HISTORIC AREAL MAPS


AOI 1
AOI 4
AOI 4
AOI 2
AOI 3
W Ridge Ave
Walker's Hewes Ave
Morton Ave
12th St
Rennie Ln
11th St
E 10th St
13
McClure Ln
Maiden Ln
W 10th St
Run
Green St
5th St
Market St
2nd St
Blueball Ave
W 2nd St
Creek
Middle
1898



Legend

- Approximate Areas of Interest (AOIs)
- Approximate Property Boundary

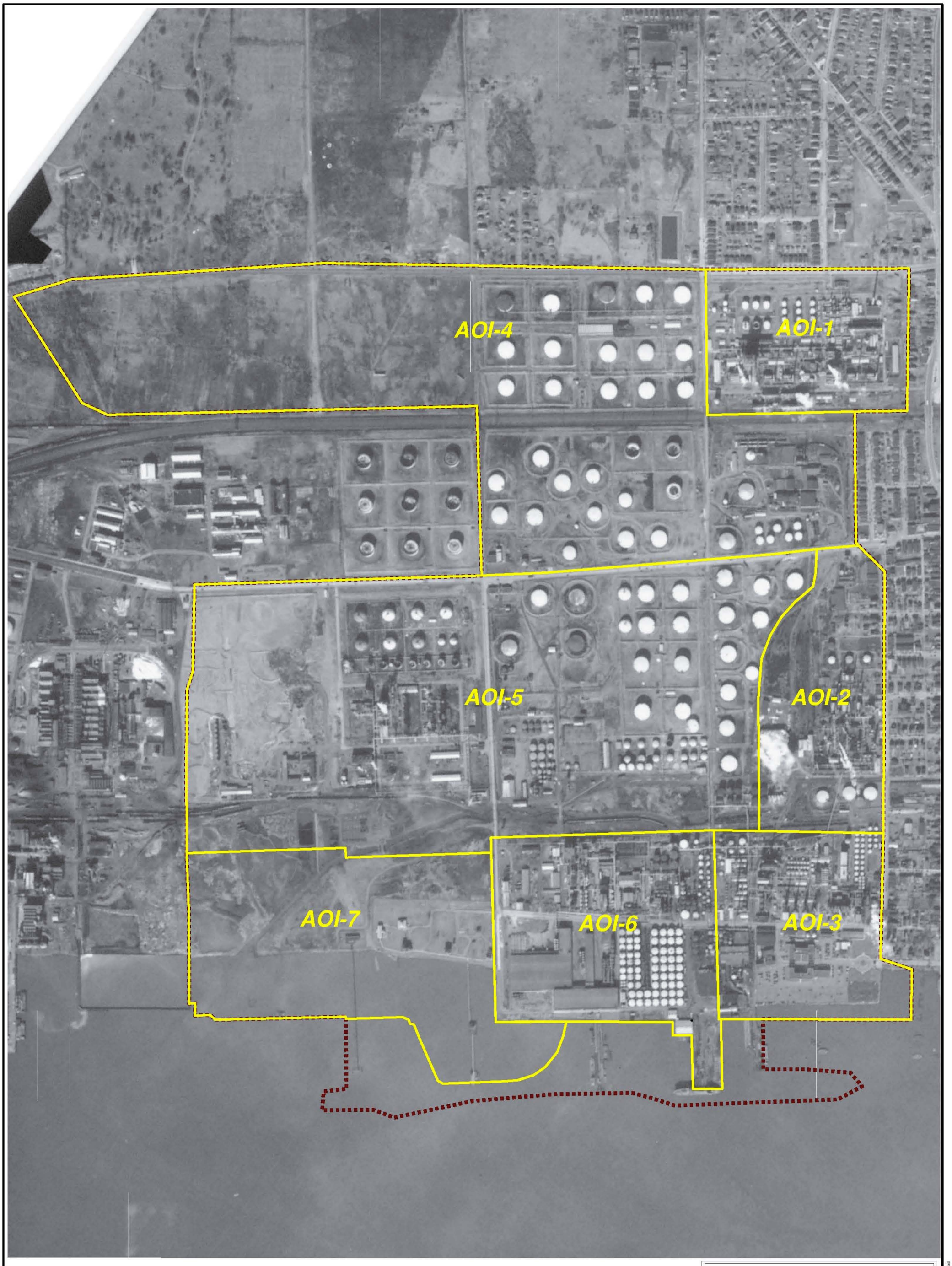
NOTES:
1. Aerial photograph dated September 18, 1937.

1937 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet


1937



Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

NOTES:
1. Aerial photograph dated February 18, 1951.

1951 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet


1953


1954


1958

AOI-4

AOI-1

AOI-5

AOI-2

AOI-7

AOI-6

AOI-3

N

W

E

S

Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

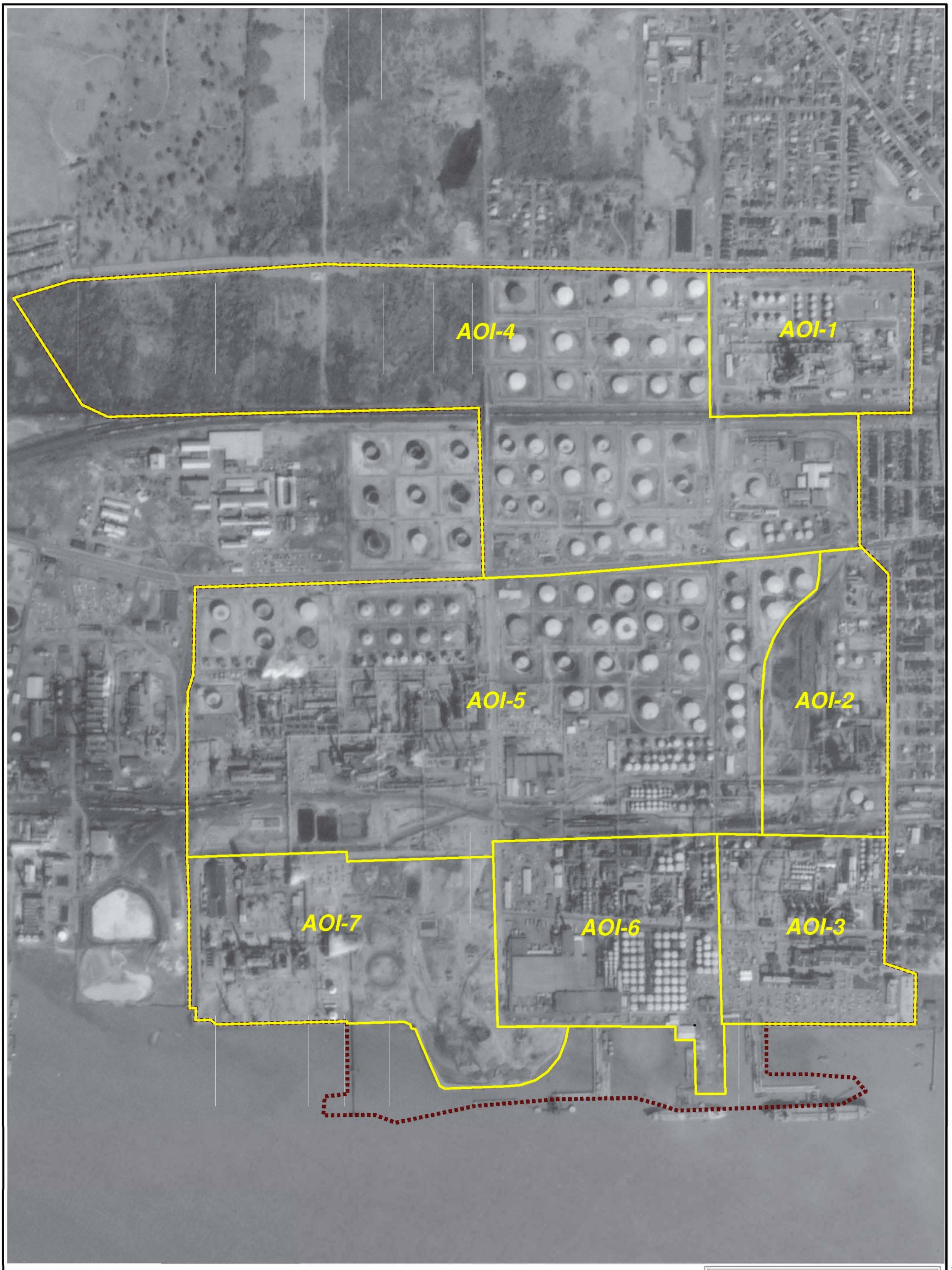
NOTES:
1. Aerial photograph dated January 13, 1962

1962 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet


1965



N
W
E
S

Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

NOTES:
1. Aerial photograph dated April 8, 1970.

1970 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet

SCALE: 1" = 280
DATE: June 17, 2011
DRN. BY: MR
CHK. BY: BM
JOB #: 2500238.1

Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

NOTES:
1. Aerial photograph dated March 28, 1982.

1982 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA.

0 140 280 560 Feet

AOI-4

AOI-1

AOI-5

AOI-2

AOI-7

AOI-6

AOI-3

Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

NOTES:
1. Aerial photograph dated April 20, 1989

1989 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet

Legend

Approximate Areas of Interest (AOIs)

Approximate Property Boundary

NOTES:
1. Aerial photograph dated September 24, 1999.

1999 Aerial Photograph
Current Conditions Report
Sunoco Marcus Hook Refinery
Marcus Hook, Pennsylvania

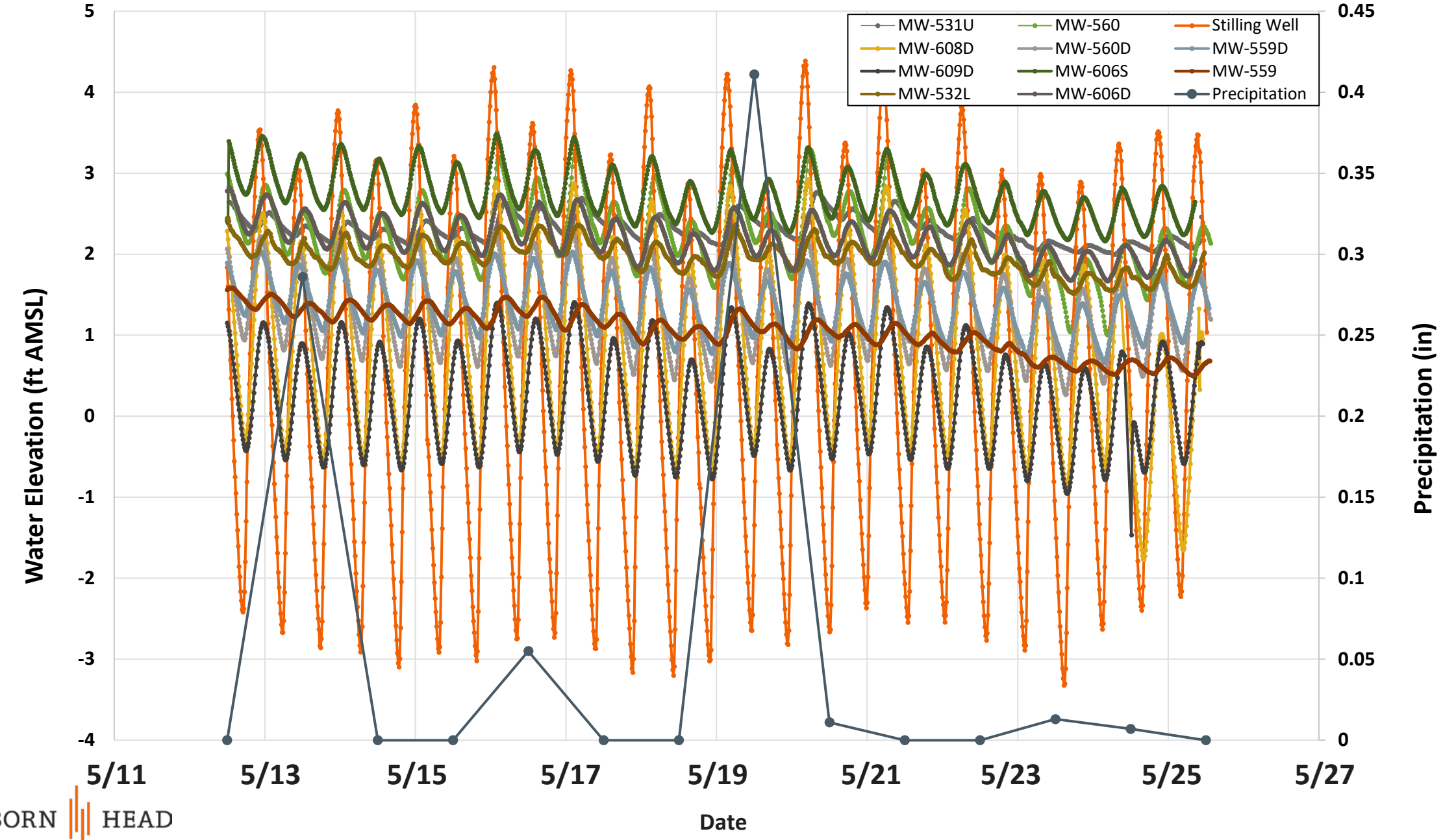
Sunoco, Inc.
Marcus Hook Refinery
Philadelphia, PA

0 140 280 560 Feet

ATTACHMENT B

GRAPHS OF TRANSDUCER DATA AND BORESCOPE DATA

Pressure Transducer Data – All Data, May 2022

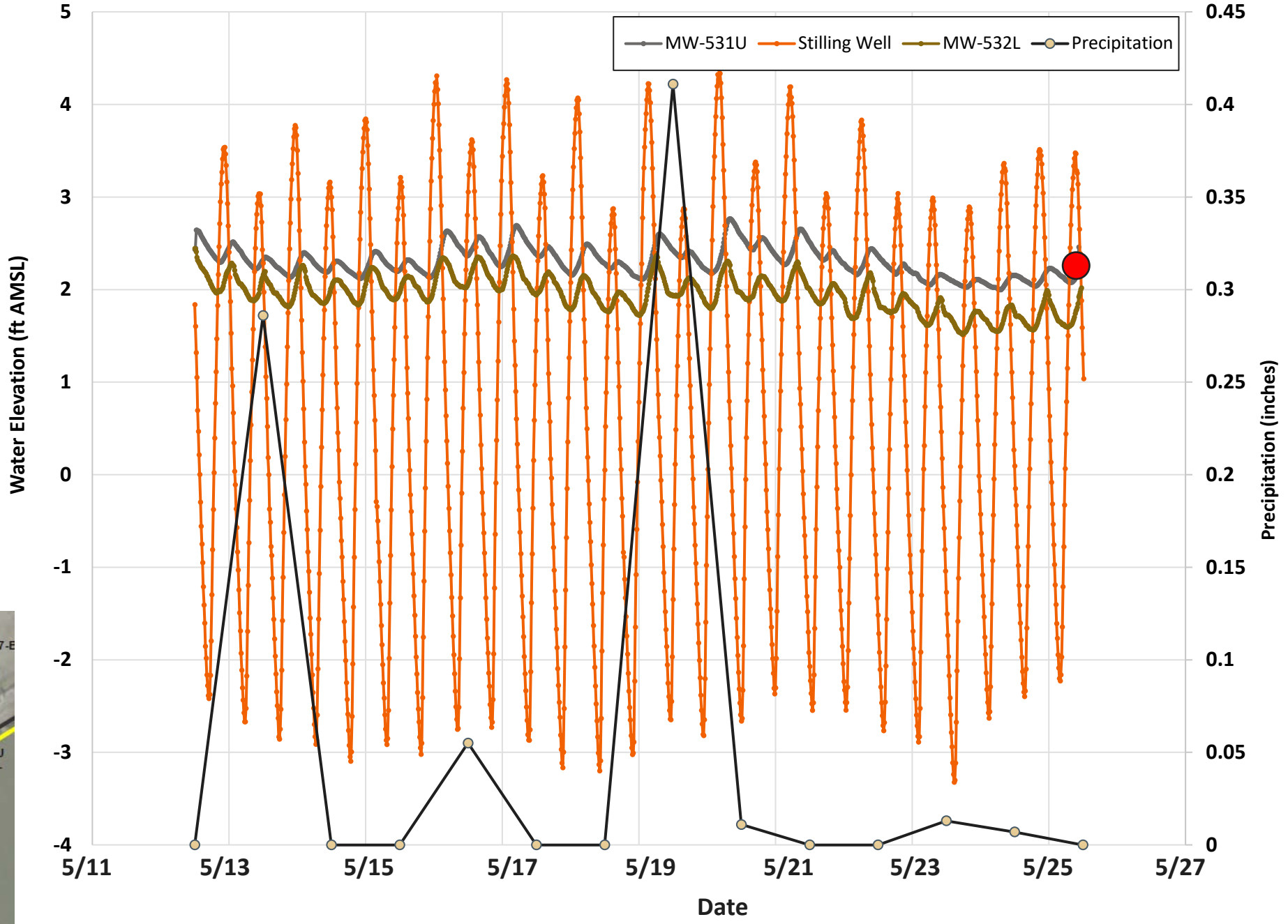


SANBORN HEAD

Pressure Transducer Data MW-531U/ MW-532L

Legend:

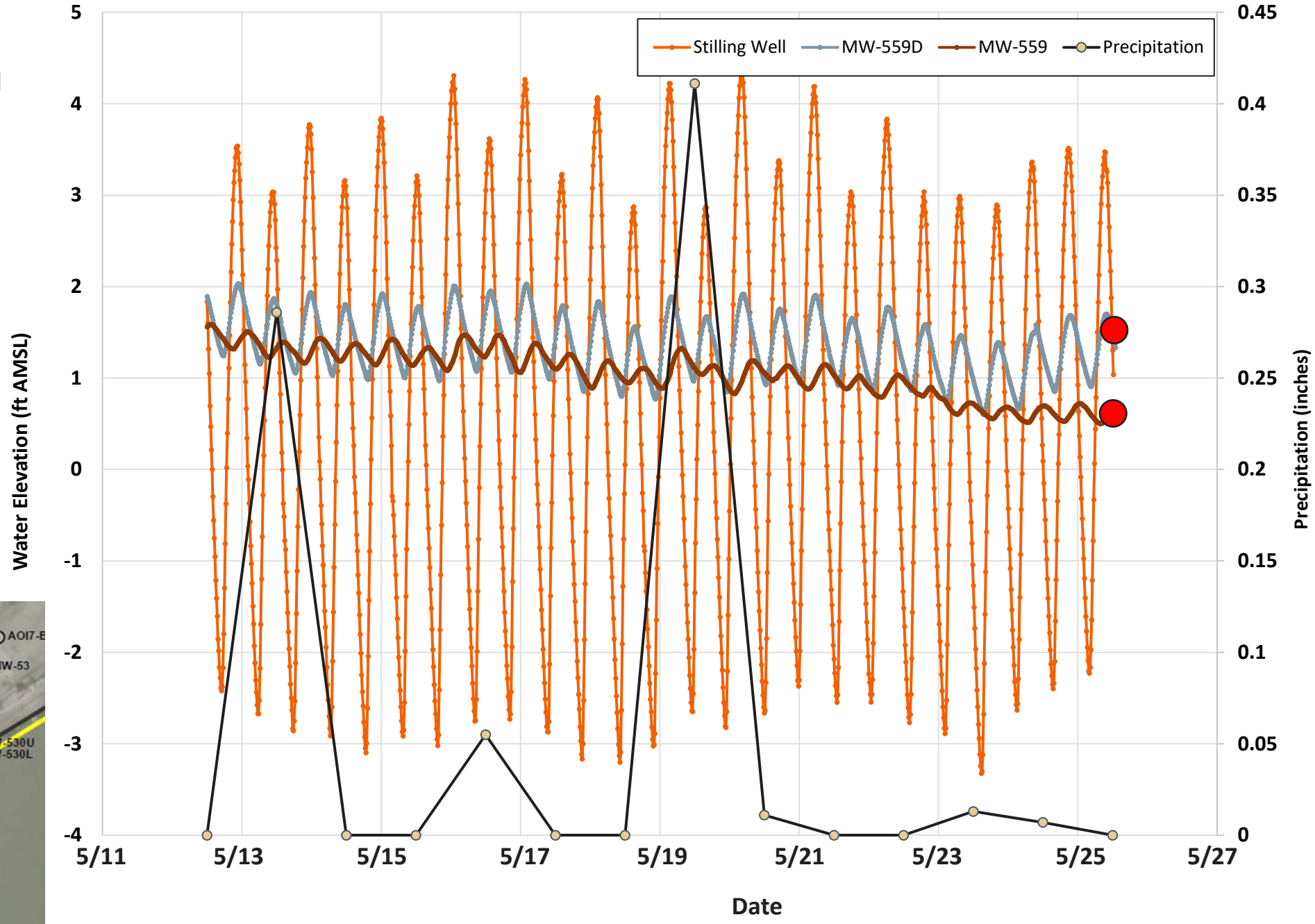
- Time of Colloidal Borescope Data Collection
- Shallow Groundwater Flow Direction Based on Borescope



Pressure Transducer Data MW-559/ MW-559D

Legend:

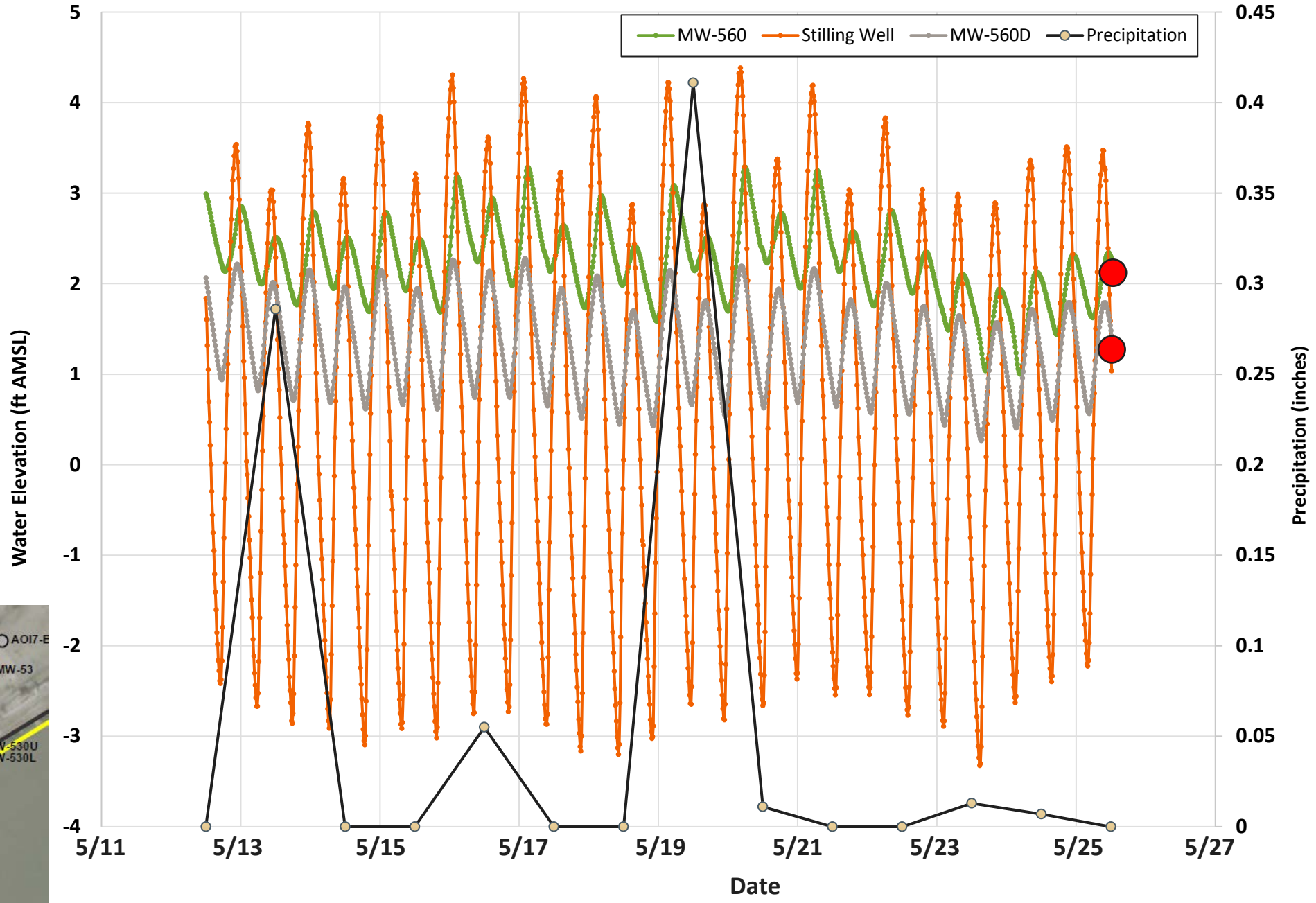
- Time of Colloidal Borescope Data Collection
- Shallow Groundwater Flow Direction Based on Borescope
- Deep Groundwater Flow Direction Based on Borescope



Pressure Transducer Data MW-560/ MW-560D

Legend:

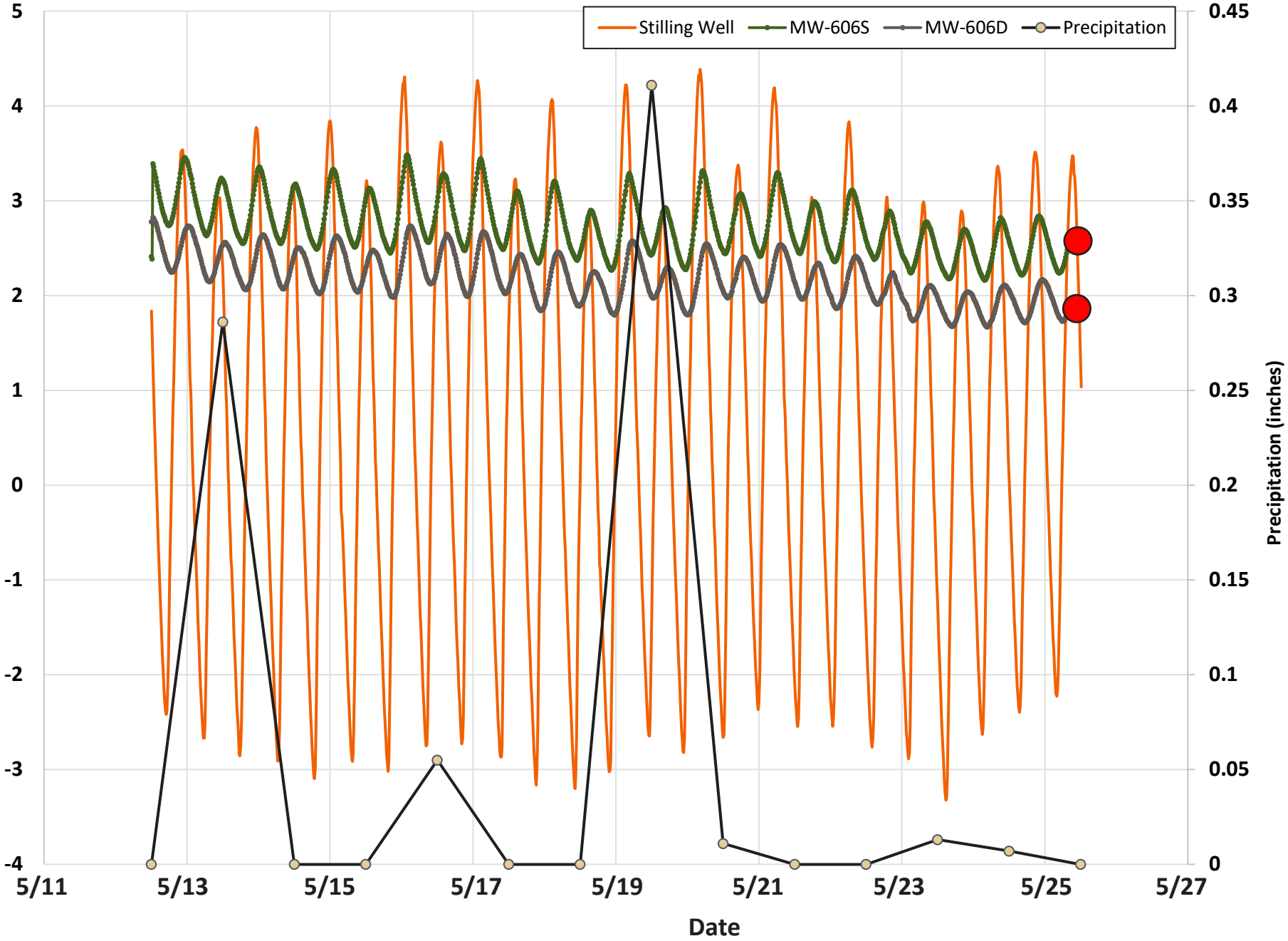
- Time of Colloidal Borescope Data Collection
- Shallow Groundwater Flow Direction Based on Borescope
- Deep Groundwater Flow Direction Based on Borescope



Pressure Transducer Data MW-606S/ MW-606D

Legend:

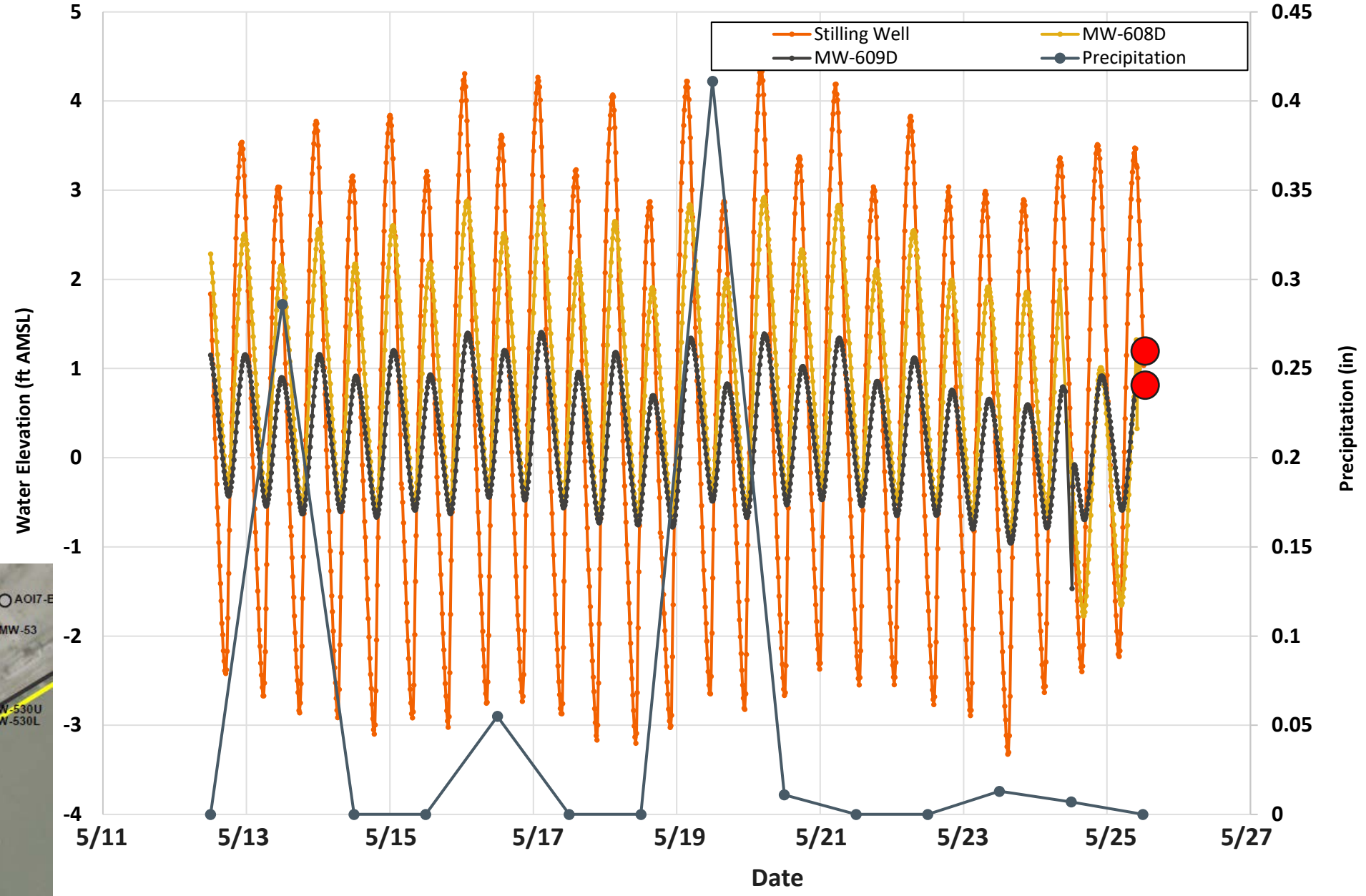
- Time of Colloidal Borescope Data Collection
- Shallow Groundwater Flow Direction Based on Borescope
- Deep Groundwater Flow Direction Based on Borescope

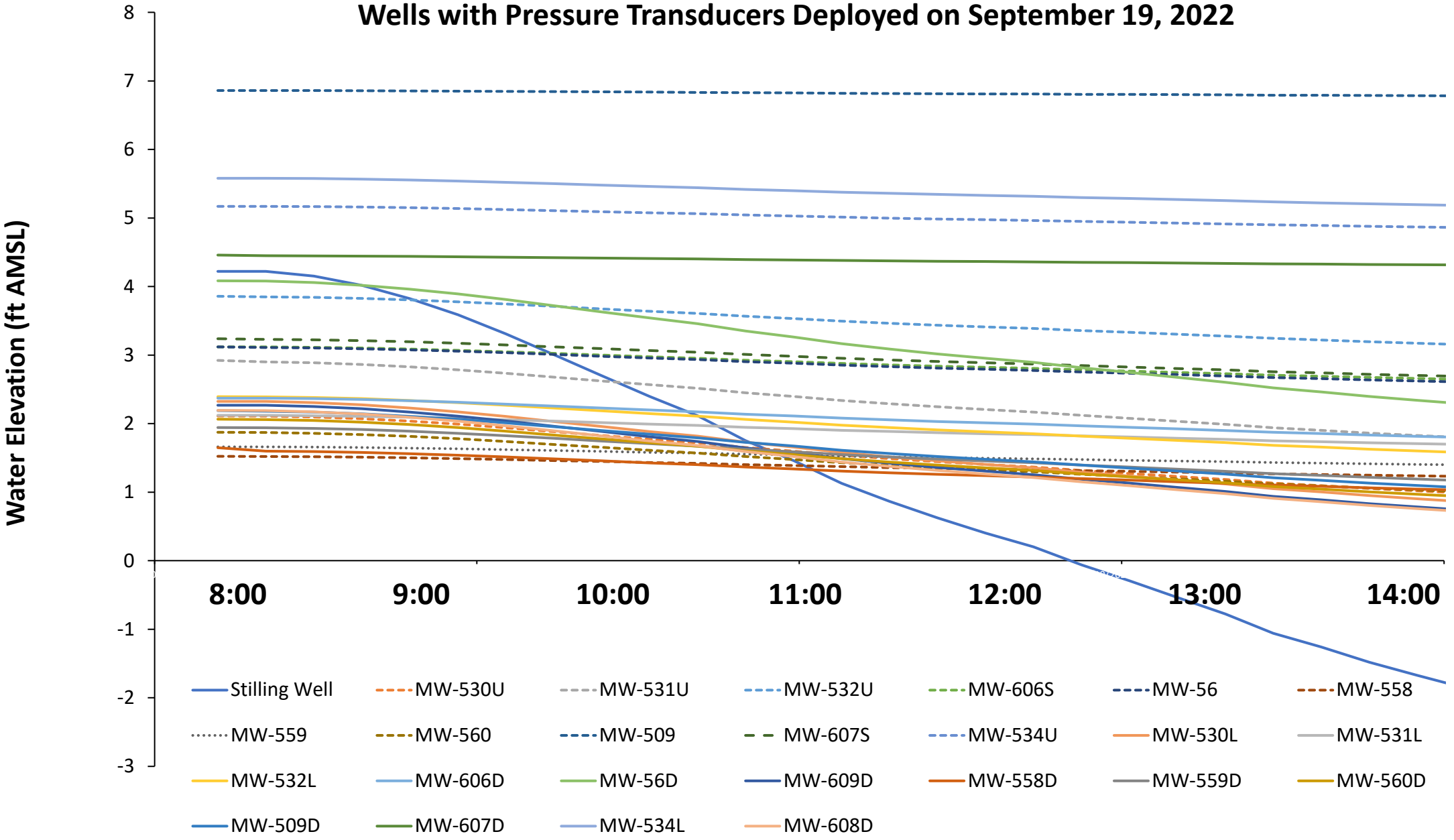


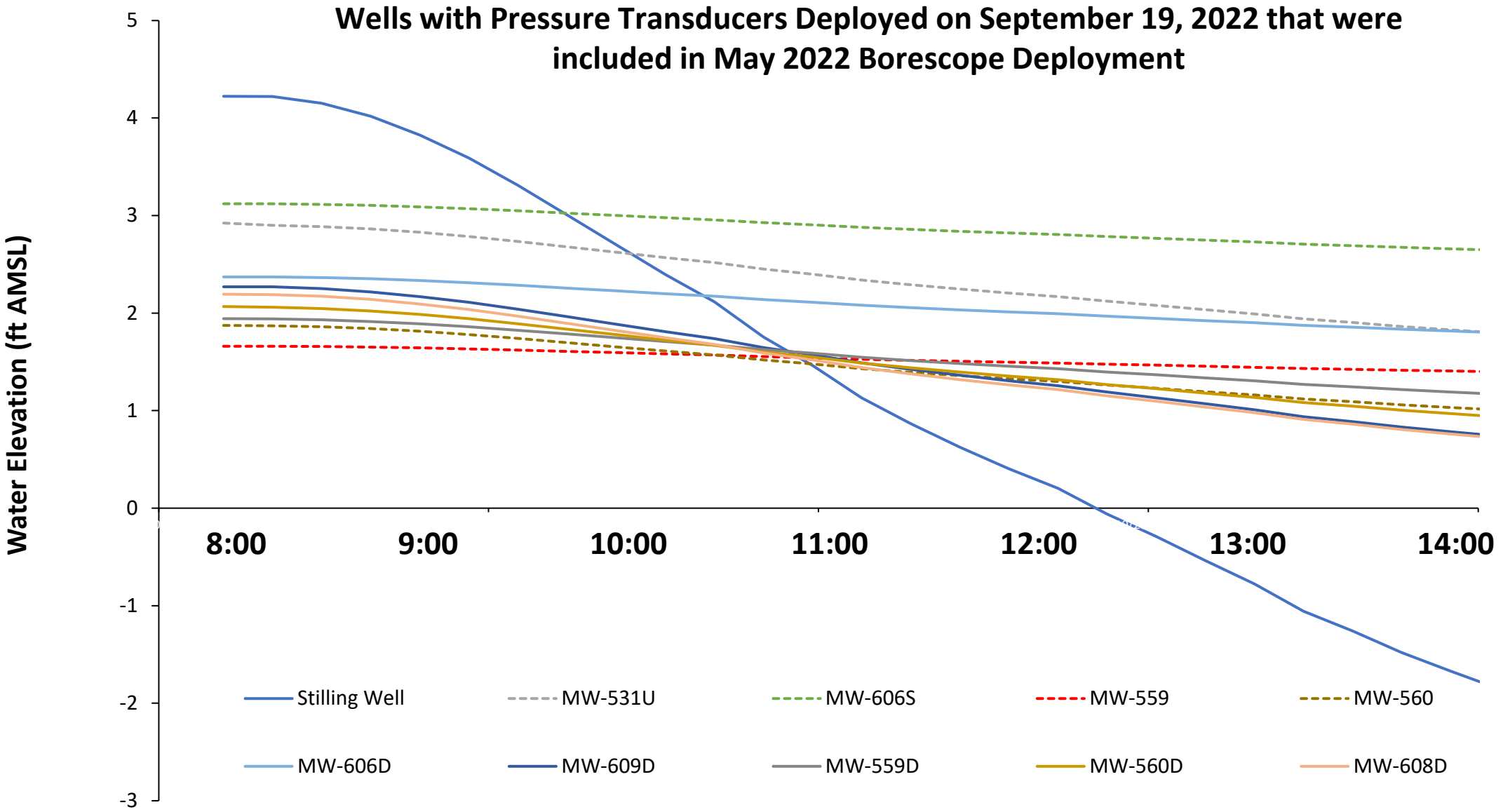
Pressure Transducer Data MW-608D/ MW-609D

Legend:

- Time of Colloidal Borescope Data Collection
- Deep Groundwater Flow Direction Based on Borescope




Wells with Pressure Transducers Deployed on September 19, 2022
Water Elevation (ft AMSL)
8
7
6
5
4
3
2
1
0
-1
-2
-3
8:00
9:00
10:00
11:00
12:00
13:00
14:00
Stilling Well
MW-530U
MW-531U
MW-532U
MW-606S
MW-56
MW-558
MW-559
MW-560
MW-509
MW-607S
MW-534U
MW-530L
MW-531L
MW-532L
MW-606D
MW-56D
MW-609D
MW-558D
MW-559D
MW-560D
MW-509D
MW-607D
MW-534L
MW-608D


Wells with Pressure Transducers Deployed on September 19, 2022 that were included in May 2022 Borescope Deployment
Water Elevation (ft AMSL)
5
4
3
2
1
0
-1
-2
-3
8:00
9:00
10:00
11:00
12:00
13:00
14:00
Stilling Well
MW-531U
MW-606S
MW-559
MW-560
MW-606D
MW-609D
MW-559D
MW-560D
MW-608D

Attachment C – Arsenic Mass Discharge Calculations

Calculations

1. $Q_{gw} = KiA$
2. $M = t\ C\ Q_{gw}$
3. $C_{sw} = \frac{M}{(Q_{gw}+DF*Q_{gw})}$

Input Parameters

Input Parameter	Value	Units
Hydraulic Conductivity, K	0.125	ft/d
Hydraulic Gradient, i	0.006968	ft/ft
Area, A	Based on Cross Section A-A'	ft^2
Concentration, C	Based on Cross Section A-A'	ug/L
% Time of Discharge to Surface Water, t	70%	-
Dilution Factor	10,000	-

Calculated Parameters

Calculated Parameter	Value	Units
Groundwater Flow, Qgw	75.8	L/d
Mass Discharge, M	0.039	g/d
Surface Water Concentration, Csw	0.052	ug/L

Abbreviations

ft – feet
d – day
ft^2 – square feet
ug – micrograms
L - liters
g – grams

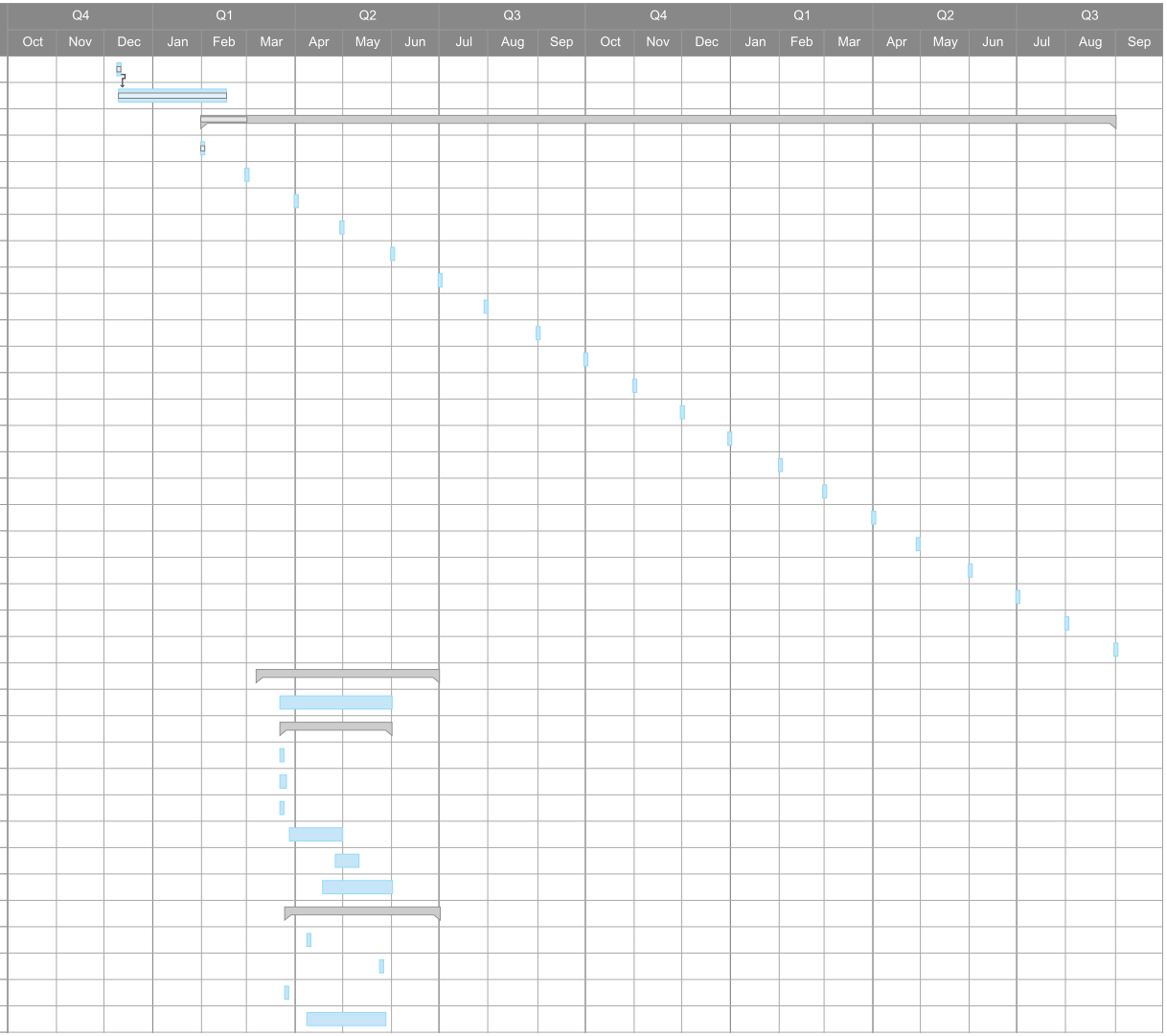
ATTACHMENT B to the September 2022 Monthly Progress Report

INTERIM MEASURES IMPLEMENTATION SCHEDULE

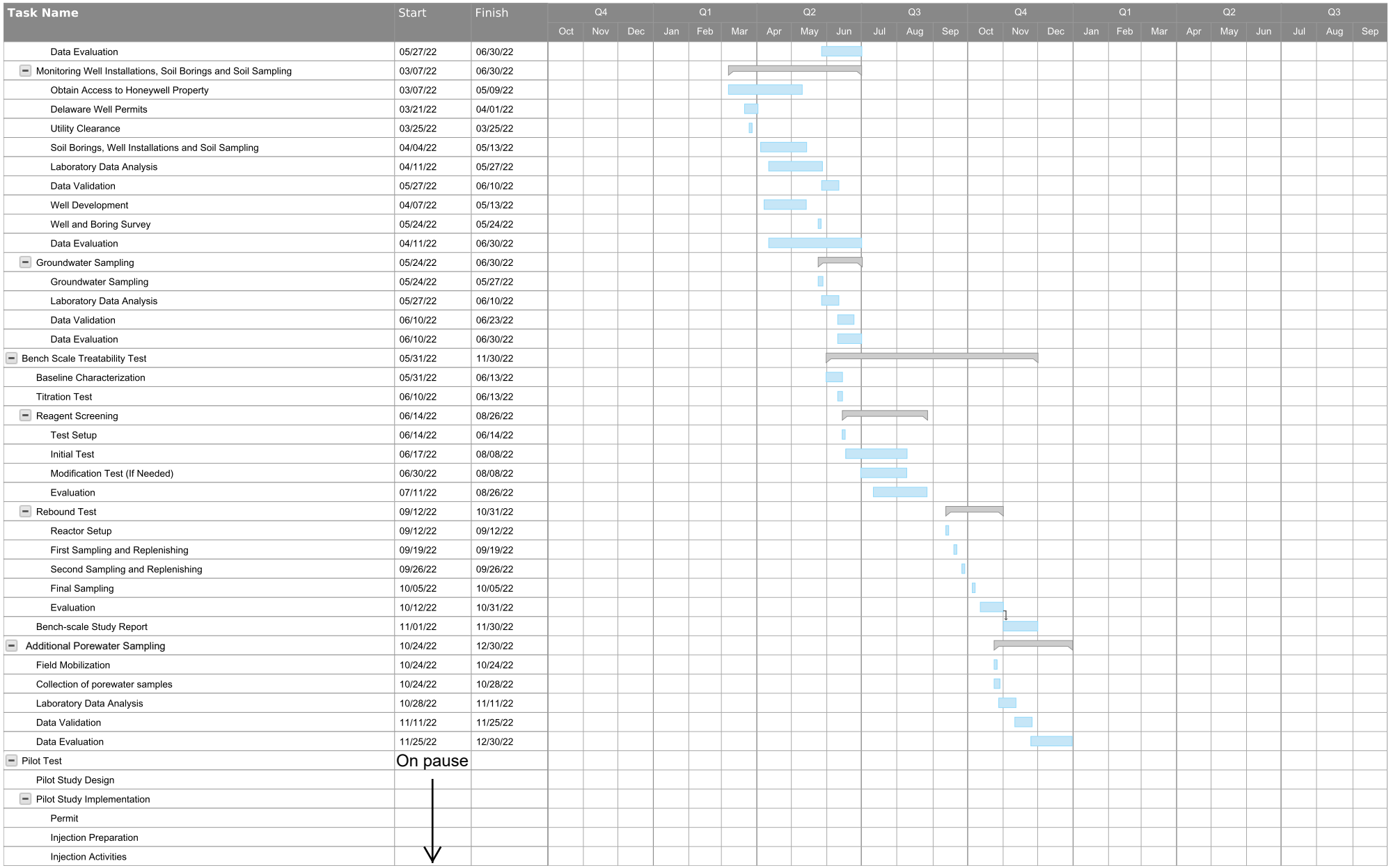
SANBORN HEAD

Attachment B
Updated Interim Measure Implementation Schedule
Evergreen
Marcus Hook, Pennsylvania

Task Name	Start	Finish
Submit IM Workplan to EPA	12/09/21	12/09/21
EPA Approval of IM Workplan	12/10/21	02/15/22
Monthly Report to EPA	01/31/22	08/31/23
January 2022 Monthly Report	01/31/22	01/31/22
February 2022 Monthly Report	02/28/22	02/28/22
March 2022 Monthly Report	03/31/22	03/31/22
April 2022 Monthly Report	04/29/22	04/29/22
May 2022 Monthly Report	05/31/22	05/31/22
June 2022 Monthly Report	06/30/22	06/30/22
July 2022 Monthly Report	07/29/22	07/29/22
August 2022 Monthly Report	08/31/22	08/31/22
September 2022 Monthly Report	09/30/22	09/30/22
October 2022 Monthly Report	10/31/22	10/31/22
November 2022 Monthly Report	11/30/22	11/30/22
December 2022 Monthly Report	12/30/22	12/30/22
January 2023 Monthly Report	01/31/23	01/31/23
February 2023 Monthly Report	02/28/23	02/28/23
March 2023 Monthly Report	03/31/23	03/31/23
April 2023 Monthly Report	04/28/23	04/28/23
May 2023 Monthly Report	05/31/23	05/31/23
June 2023 Monthly Report	06/30/23	06/30/23
July 2023 Monthly Report	07/31/23	07/31/23
August 2023 Monthly Report	08/31/23	08/31/23
PDI	03/07/22	06/30/22
PDI Mobilization	03/22/22	05/31/22
Sediment and Porewater Sampling	03/22/22	05/31/22
Field Mobilization	03/22/22	03/22/22
Collection of sediment samples and grab porewater samples	03/22/22	03/25/22
Collection of DGT porewater samples	03/22/22	03/23/22
Laboratory Data Analysis	03/28/22	04/29/22
Data Validation	04/26/22	05/10/22
Data Evaluation	04/18/22	05/31/22
GW Elevation and GW Flow Evaluation	03/25/22	06/30/22
Installation of Transducers	04/08/22	04/08/22
Deployment of Groundwater Flow Meter	05/24/22	05/24/22
Install stilling well	03/25/22	03/25/22
Data Collection	04/08/22	05/27/22



Task Name	Start	Finish
Data Evaluation	05/27/22	06/30/22
Monitoring Well Installations, Soil Borings and Soil Sampling	03/07/22	06/30/22
Obtain Access to Honeywell Property	03/07/22	05/09/22
Delaware Well Permits	03/21/22	04/01/22
Utility Clearance	03/25/22	03/25/22
Soil Borings, Well Installations and Soil Sampling	04/04/22	05/13/22
Laboratory Data Analysis	04/11/22	05/27/22
Data Validation	05/27/22	06/10/22
Well Development	04/07/22	05/13/22
Well and Boring Survey	05/24/22	05/24/22
Data Evaluation	04/11/22	06/30/22
Groundwater Sampling	05/24/22	06/30/22
Groundwater Sampling	05/24/22	05/27/22
Laboratory Data Analysis	05/27/22	06/10/22
Data Validation	06/10/22	06/23/22
Data Evaluation	06/10/22	06/30/22
Bench Scale Treatability Test	05/31/22	11/30/22
Baseline Characterization	05/31/22	06/13/22
Titration Test	06/10/22	06/13/22
Reagent Screening	06/14/22	08/26/22
Test Setup	06/14/22	06/14/22
Initial Test	06/17/22	08/08/22
Modification Test (If Needed)	06/30/22	08/08/22
Evaluation	07/11/22	08/26/22
Rebound Test	09/12/22	10/31/22
Reactor Setup	09/12/22	09/12/22
First Sampling and Replenishing	09/19/22	09/19/22
Second Sampling and Replenishing	09/26/22	09/26/22
Final Sampling	10/05/22	10/05/22
Evaluation	10/12/22	10/31/22
Bench-scale Study Report	11/01/22	11/30/22
Additional Porewater Sampling	10/24/22	12/30/22
Field Mobilization	10/24/22	10/24/22
Collection of porewater samples	10/24/22	10/28/22
Laboratory Data Analysis	10/28/22	11/11/22
Data Validation	11/11/22	11/25/22
Data Evaluation	11/25/22	12/30/22
Pilot Test	On pause	
Pilot Study Design		
Pilot Study Implementation		
Permit		
Injection Preparation		
Injection Activities		



Task Name	Start	Finish	Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3		
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pilot Study Monitoring	On pause																									
Baseline Sampling																										
First Performance Monitoring																										
Second Performance Monitoring																										
Third Performance Monitoring																										
Fourth Performance Monitoring																										
CMS																										
Design of Final Remedy																										
Submittal of CMS																										